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HYDRAULIC LABORATORY BULLETIN
Series A

CURRENT HYDRAULIC LABORATORY RESEARCH IN THE UNITED STATES

Bulletin X
January, 1942

Intake Towers, Boulder Dam,
(By permission, U. S. Bureau of Reclamation)

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IN THE UNITED STATES

Compiled by the National Bureau of Standards, U. S. Department of Commerce, Washington, D. C.

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INTRODUCTION

The following list shows what issues of National Bureau of Standards Hydraulic Laboratory Bulletins, Series A and B, have appeared and which are still available for distribution.

Series A. Current Hydraulic Laboratory Research in the United States.

Volume I-1, April 1, 1933.	Supply exhausted.	Volume IV-2, July 1, 1936.	
" I-2, July 1, 1933.	" "	" V-1, January 1, 1937.	
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Series B. Hydraulic Laboratories in the United States.

First issue, 1933. Supply exhausted.
First revision, 1935. " "

The information contained in these bulletins is compiled with the cooperation of the various hydraulic and hydrologic laboratories in the United States. The Series A bulletins give an annual summary of research that is in progress in these laboratories and thus make known to hydraulic laboratory staffs, to engineers who design hydraulic structures, and to hydrologists the existence of studies that frequently would come to their attention only at much later dates, when the results are published.

The Series B bulletins give a brief description of the hydraulic laboratories in the United States and their experimental equipment. They are issued only at infrequent intervals. These bulletins perform a useful service in showing at a glance where facilities exist for tests that require very special equipment or conditions. The last issue of this bulletin is now exhausted. Another bulletin in this series had been contemplated during the past year, but it was found necessary to postpone it indefinitely.

A change in the form of the bulletin has been initiated with the present issue owing to the necessity for economizing in the use of paper. No attempt has been made to curtail the amount of material included, but the reports are presented in more compact form than has been done previously.

It is emphasized again that the National Bureau of Standards does not have in its files reports or detailed information regarding the research projects reported by other organizations. Any person who wishes to obtain information regarding any project reported in this Bulletin should write to the Correspondent listed under (e) for that project. The Correspondent's address can be found in the Directory at the beginning of this Bulletin.

Copies of this bulletin are supplied to interested persons and organizations without charge. A mailing list is maintained which includes the names of such persons as have requested in writing that this service be furnished them.

In writing to the National Bureau of Standards in regard to any matter concerning this bulletin, please refer to our reference VI-6/INHU.

Key to Projects.

(a) Title of project:	(d) Investigators:	(g) Method and scope:
(b) Project conducted for:	(e) Correspondent:	(h) Progress:
(c) Nature of project:	(f) Purpose:	(i) Remarks:

CURRENT PROJECTS IN HYDRAULIC LABORATORIES

UNIVERSITY OF ARKANSAS

(1268) (a) RUN-OFF STUDY. (b) Engineering Experiment Station, University of Arkansas. (c) Study of run-off and time of concentration of flood flows from the steep head water of White River. (e) Prof. W. R. Spencer.

CALIFORNIA INSTITUTE OF TECHNOLOGY (Cooperative Laboratory, Soil Conservation Service)

(659) (a) MECHANICS OF SUSPENDED LOAD TRANSPORTATION. (b) Sedimentation Division, Soil Conservation Service, U. S. Department of Agriculture. (c) Cooperative research program with Soil Conservation Service. (d) Prof. Robert T. Knapp, Dr. Vito A. Vanoni. (e) Prof. Robert T. Knapp, Dr. Vito A. Vanoni. (f) To investigate the internal mechanics of transportation of suspended load by flowing water; the effects of the material in suspension upon the velocity distribution of the flow; the distribution of sediment in open channel flow. (g) (h) (i) For details of experiments and summary of results to date, see Some Experiments on the Transportation of Suspended Load - by Vito A. Vanoni. Transactions, American Geophysical Union 1941 - Part III - pp. 608. The study is being continued.

(660) (a) DEVELOPMENT OF A HOT-WIRE VELOCITY METER FOR USE IN WATER. (b) Sedimentation Division, Soil Conservation Service, U. S. Department of Agriculture. (c) Cooperative research program with Soil Conservation Service. (d) Vito A. Vanoni, E. E. Simmons. (e) Prof. Robert T. Knapp, Dr. Vito A. Vanoni. (f) To develop an instrument suitable for use in determining velocity distribution in flows carrying sediments. (g) Calibration of hot-wire instrument with alternating and direct current circuits in a 3/4-inch orifice. (h) Work on this problem was interrupted after some preliminary tests had been made and before sufficient progress was realized to warrant a report. The project is still inactive owing to lack of personnel.

(810) (a) THE STUDY OF SEDIMENT-LADEN FLOWS (DENSITY CURRENTS) IN RESERVOIRS. (b) Sedimentation Division, Soil Conservation Service. (c) Cooperative research program with Soil Conservation Service. (d) Prof. Robert T. Knapp, Hugh Stevens Bell. (e) Prof. Robert T. Knapp, Dr. Vito A. Vanoni, Project Supervisor. (f) To investigate density currents resulting from suspensions of fine sediments in reservoirs,and to attempt to establish principles governing their behavior. (g) (h) (i) For details of experiments and results to date see Density Currents - by Robert T. Knapp and Hugh Stevens Bell, Transactions, American Geophysical Union, 1941, Part II, p. 257. The study is being continued.

(812) (a) HYDRAULIC DESIGN OF EROSION-CONTROL STRUCTURES BY MEANS OF MODEL TESTS. (b) Hydrologic Division and Operations Division, Southwest Region, Soil Conservation Service, U. S. Department of Agriculture, Office of Research. (c) Cooperative research program with Soil Conservation Service. (d) Brooks T. Morris, Vito A. Vanoni. (e) Prof. Robert T. Knapp, Dr. Vito A. Vanoni, Project Supervisor. (f) (g) See Bulletin IX, 1941. (h) This study has been reported in a paper, "Hydraulic Design of Drop Structures for Gully Control," by B. T. Morris and D. C. Johnson, which has been accepted for publication in Proceedings, American Society of Civil Engineers.

(1101) (a) THE STABILITY OF NATURAL SEDIMENTS UNDER LOCALLY CONCENTRATED ATTACK OF FLOWING WATER. (b) Sedimentation Division, Soil Conservation Service, U. S. Department of Agriculture. (c) Cooperative research program with Soil Conservation Service. (d) Brooks T. Morris. (e) Prof. Robert T. Knapp, Dr. Vito A. Vanoni, Project Supervisor. (f) To establish a rational basis for the prediction of the rate of scour of natural or artificially placed sediments or pavements at the foot of drop structures, overfall dams, and natural waterfalls. (g) An analysis suggested by the study of the results of the simplified scour apparatus (see Bulletin VIII and IX) is being applied to various typical scour problems of the sort presented in project (812). (h) The identification of the process of localized scour as merely a special case of sediment suspension has permitted a general breakdown of the scour problem. Reports stating a general analysis of the scour problem and applying it to the design of erosion-control structures are being prepared.

(1102) (a) THE DEVELOPMENT OF METHODS OF DISSIPATING ENERGY BELOW DROPS. (b) Hydrologic Division, Soil Conservation Service, U. S. Department of Agriculture. (c) Cooperative research program with Soil Conservation Service. (d) Walter L. Moore and Brooks T. Morris. (e) Prof. Robert T. Knapp and Dr. Vito A. Vanoni, Project Supervisor. (f) To study energy dissipation in a drop with a view to evaluating the effectiveness of the various design features of drop structures in producing stilling and minimizing downstream erosion. (g) Study is completed and results are published under the title, Energy Loss at the Base of a Free Overfall, by Walter L. Moore, Proceedings of American Society of Civil Engineers, Vol. 67, No. 9, p. 1697, November,1941.

(1269) (a) HYDRAULIC DESIGN OF BAFFLE-TYPE ENERGY DISSIPATORS FOR PIPE OUTLETS BY MEANS OF LABORATORY TESTS. (b) Sedimentation Division, Office of Research and Engineering Division, Pacific Southwest Region, Soil Conservation Service, U. S. Department of Agriculture. (c) Cooperative research program with Soil Conservation Service. (d) Brooks T. Morris. (e) Prof. Robert T. Knapp, Dr. Vito A. Vanoni, Project Supervisor. (f) To analyse and improve existing design and to develop new designs for erosion control structures of the pipe outlet type used in field operation. (g) Through elementary as well as complete models the performance of the field structures is studied in the laboratory. Collaboration of field technician is relied upon to determine reliability of assumption used in analysis and on workability of new designs. (h) Study newly initiated in place of completed project (812).

CALIFORNIA INSTITUTE OF TECHNOLOGY. (Hydraulic Structures Laboratory.)

(1159) (a) INVESTIGATION OF THE RESISTANCE COEFFICIENT OF A RECTANGULAR CHANNEL FOR BOTH TRANQUIL AND SHOOTING FLOWS. (b) Laboratory project. (c) Research for thesis for M. S. degree. (d) L. G. Waigand. R. H. Weight. (e) Prof. Robert T. Knapp, Dr. Vito A. Vanoni. (f) To determine the effect of change in flow type on the resistance coefficient of the channel. (g) Experiments will be conducted in a brass channel 18" wide and 100 ft long. Both slope and discharge will be varied to cover the desired range. (h) Preliminary experiments completed and results reported in thesis for Master's Degree.

CALIFORNIA INSTITUTE OF TECHNOLOGY. (Hydraulic Machinery Laboratory.)

(821) (a) STUDY OF PRE-ROTATION AND REVERSE FLOW AT THE EYE OF A CENTRIFUGAL PUMP. (b) U.S. Bureau of Reclamation research program. (c) Research for thesis for Ph. D. degree. (d) James W. Daily. (e) Professors R. T. Knapp, R. L. Daugherty, and Th. von Kármán. (f) Experimental verification of the flow characteristics within a centrifugal pump, especially in the region near the impeller eye. (g) Special equipment has been constructed for use with the cylindrical direction-finding type pitot tube. Velocity and static pressures as well as direction of flow are obtained with the aid of zero-volume differential gages. The existing flow picture is correlated with the performance characteristics of the pump. (h) Measurements have shown conclusively that pre-rotation existing in the pipe leading to the inlet of a centrifugal pump is accompanied by an actual mass transfer of water out of the impeller at the periphery of the eye. This mass of water flows upstream along the periphery of the pipe with a rotational component dependent upon the speed of the pump and the mean rate of flow. The increase in pressure at the pipe wall due to the rotation often results in measured pressure gradients increasing in the direction of the mean flow. At low capacities the backflow can amount to many times the magnitude of the mean flow through the pump.

(822) (a) STUDY OF EFFECT OF AIR CONTENT ON CAVITATION PERFORMANCE OF CENTRIFUGAL PUMPS. (b) U. S. Bureau of Reclamation. (c) Cooperative research program with U. S. Bureau of Reclamation. (d) Hydraulic Machinery Laboratory staff. (e) Professors R. T. Knapp, R. L. Daugherty, and Th. von Kármán. (f) To determine effect of dissolved air on cavitation performance. (g) Investigation of the validity of bubble point as cavitation parameter. An apparatus was constructed for the purpose of accurately determining the bubble-point pressure as a function of temperature. Bubble-point measurements were correlated with the cavitation limits determined from precise dynamometer tests. (h) Preliminary results of bubble-point measurements for water samples taken from pumping circuit during cavitation tests indicate that, within the limits of the amounts of air dissolved under equilibrium pressures ranging from 1 to 0.1 atmosphere, the effect on the pump efficiency in the vicinity of the breakoff point and on the breakoff point itself probably does not exceed 1% or 2%.

(827) (a) DETERMINATION OF BOTH AVERAGE AND INSTANTANEOUS VELOCITY AND PRESSURE DISTRIBUTIONS IN THE VOLUTE OF A CENTRIFUGAL PUMP. (b) Hydraulic Machinery Laboratory research program. (c) General laboratory investigation. (d) Hydraulic Machinery Laboratory staff. (e) Professors Th. von Kármán, R. T. Knapp, R. L. Daugherty. (f) Experimental verification of the flow characteristics in the pump volute. (g) By means of a precision dual-slide valve and special differential gage, instantaneous readings of velocity and pressure are being obtained. Their correlation with the average distributions furnish an experimental basis for an analytical examination of centrifugal pump performance. (h) Measurements have been completed for two different types of volute pumps. Correlation of the results with existing theoretical flow pictures is being made.

(829) (a) COMPILATION OF COMPLETE CHARACTERISTIC PERFORMANCE OF CENTRIFUGAL PUMPS OF VARIOUS TYPES AND SPECIFIC SPEEDS. (b) Hydraulic Machinery Laboratory research program. (c) General laboratory research. (d) R. T. Knapp, and James W. Daily. (e) Professors Th. von Kármán, R. T. Knapp, and R. L. Daugherty. (f) (g) Complete characteristic diagrams of centrifugal pumps are necessary for use in analyzing the transient behavior of pumps in specific installations. A series of diagrams for all types of centrifugal pumps is being compiled for comparison purposes. (h) Preliminary publication made in A.S.M.E. Transactions, November, 1937, Hydr.-59-11, by R. T. Knapp, "Complete Characteristics of Centrifugal Pumps and their use in the Prediction of Transient Behavior." A brief discussion of complete characteristic diagrams and calculated transient behavior for two additional pumps is presented in the article referred to under Project 818 (1941).

(830) (a) AN EVALUATION OF STEPS NECESSARY IN ANALYTICAL REDUCTION OF DATA OBTAINED FROM PRECISION TESTS OF HYDRAULIC MACHINES. (b) Hydraulic Machinery Laboratory research program. (c) General laboratory research. (d) James W. Daily. (e) Professors Th. von Kármán, R. T. Knapp and R. L. Daugherty. (f) Refinements in testing equipment and technique require that thorough attention be given to methods of evaluation, including determination of physical constants, if all the advantages of the precision tests are to be obtained. Information is being collected and analytical methods developed for use in the Hydraulic Machinery Laboratory which are thought to be of general interest and importance. A summary of data and a description of methods are being prepared for distribution.

UNIVERSITY OF CALIFORNIA.

(723) (a) RECOVERY EFFICIENCY OF VARIOUS TYPES OF SLOWLY MOVING FLUID INTERFACES. (b) Standard Oil Company of California Research Fellowship. (c) Laboratory project. (d) R. G. West. (e) Prof. M. P. O'Brien. (f) To determine the most efficient method of repress ring media for oil recovery. (g) Measure recovery of oil from a cylinder of oil-saturated sand using water and gas drives. (h) Continuation of work of D. R. Rankin and R. L. Parsons.

(726) (a) PUMP TESTING LABORATORY. (b) Laboratory investigation. (d) R. G. Folsom. (e) Prof. M. P. O'Brien. (f) Research in the general field of pumping. (g) Present investigations include: 1. Research in the field of deep-well and propeller pumps. 2. Analysis of laboratory and field methods of testing, development of test standards, and calibration of test instruments. 3. Tests of motors, bearings, and other auxiliary equipment. 4. Tests of manufacturers' types. 5. Tests on specific pumps and pump accessories and equipment. (h) The equipment is in operation.

(801) (a) FRICTION LOSSES IN ANGULAR-CONTACT THRUST BEARINGS. (b) Laboratory investigation. (c) Master's thesis. (d) W. Johnson. (e) Prof. M. P. O'Brien. (f) To determine friction losses in angular-contact thrust bearings under conditions of use in deep-well turbine pumps. (g) To determine by tests: 1. Friction of ball on race. 2. Oil pumping losses. 3. Losses due to misalignment. (h) Experiments in progress.

(1045) (a) UNSTEADY FLOW OF FLUIDS THROUGH POROUS MEDIA. (b) Laboratory project. (c) Ph. D. thesis. (d) J. A. Putnam. (e) Prof. M. P. O'Brien. (f) To predict unsteady flow characteristics of porous media for homogeneous and non-homogeneous fluids. (g) Using a linear channel filled with uniformly compacted sand, measurements will be made of the variation of pressure with time and space for various boundary conditions. Both homogeneous fluids and gas-liquid mixtures will be used. (h) Experiments in progress.

(1270) (a) MIXING OF PARALLEL STREAMS. (b) Investigation in cooperation with American Society of Civil Engineers. (c) Master's thesis. (d) R. L. Johnson. (e) Prof. M. P. O'Brien. (f) To determine the rate of divergence of a high-velocity stream impinging upon a stream of lower velocity. (g) Measurement of velocity patterns by pitot tube across a section 6" x 1" in which the high velocity stream 6" x 2" in section impinges.

(1271) (a) STUDIES IN THE FLOW THROUGH POROUS MEDIA. (b) Laboratory investigation. (c) Bachelor's thesis. (d) Eugene Glenbot. (e) Prof. M. P. O'Brien. (f) Measurement of the critical escape of gradient which would exist at the toe of an earth fill dam. (g) Water is to be forced vertically upward through pipe packed with sand of various known porosities. Critical escape gradient will be noted when quicksand condition exists. (h) Testing in progress.

(1272) (a) STUDIES IN OPEN CHANNEL FRICTION. (b) Laboratory project. (c) Bachelor's thesis. (d) M. E. Fuller, R. E. Graham. (e) Prof. M. P. O'Brien. (f) An attempt to determine the distribution of friction between side walls and bottom of a rectangular open channel. (g) Velocity patterns are to be measured in open channel in which the side walls and bottom have different degrees of roughness. (h) Testing in progress.

UNIVERSITY OF CALIFORNIA (College of Agriculture)

(270) (a) THE EFFECT OF DEPTH OF WATER TABLE UPON THE LOSS OF WATER FROM THE SOIL SURFACE. (Part of project on principles of soil moisture in relation to irrigation). (b) California Agricultural Experiment Station. (c) Experiment Station project. (d) M. R. Huberty, F. J. Veihmeyer. (e) Prof. F. J. Veihmeyer. (f) This project is part of a larger project to determine losses of water through plant transpiration and surface evaporation. (g) Twenty-five tanks holding more than one ton of soil, equipped with Mariott constant water-level regulating devices, are being used. The amount of water evaporated is determined volumetrically and gravimetrically. The investigations have been under way for several years. The experiments have been conducted in such a way that a statistical analysis of the results of evaporation from the surface of the soils with the water table a constant distance below the surface can be obtained. (h) Work under this project is being continued. Record for five years has been obtained showing the loss of water from soil surface when water tables are maintained at depths of from 0.5 ft to 5 ft. This work was completed in 1939, but the report has not yet been published. Equipment is now being used to determine the ability of various agricultural crops to obtain their water supply from soils with water tables maintained at depths of from 0.5 ft to 5 ft from the surface. No published reports.

(271) (a) MOVEMENT OF MOISTURE THROUGH SOILS. (Part of project on principles of soil moisture in relation to irrigation.) (b) California Agricultural Experiment Station. (c) Experiment Station project. (d) N. E. Edlefson, F. J. Veihmeyer, L. D. Doneen, A. H. Hendrickson, M. R. Huberty, A. F. Pillsbury. (e) Prof. F. J. Veihmeyer. (f) This study is part of a general project to study movement of water in soils, both under saturated and unsaturated conditions. It also involves the movement of water to roots of plants, the energy relations involved in extraction of water by plants. (g) Extensive equipment of plant containers with suitable arrangements for determining water use, ranging from small cans to tanks containing over one ton of soil, are being used. In addition, numerous field plots with permanently rooted and annual plants, together with a specially equipped laboratory for the study of different phases of soil moisture movement, are in use. (h) Work is being continued. (i) See under heading, Abstracts of Completed Projects and References to Publications, of this Bulletin for list of reports published.

(666) (a) THERMODYNAMIC STUDIES OF EVAPORATION FROM FREE WATER, SOIL, AND PLANTS. (b) California Agricultural Experiment Station. (c) Experiment Station Project 1107. (d) F. J. Veihmeyer, N. E. Edlefson, A.B.C. Anderson, A. H. Hendrickson, C. N. Johnston, L. D. Doneen. (e) F. J. Veihmeyer. (f) Evaporation, although playing as important a role as precipitation, especially in irrigated regions, has not been studied as carefully. This is chiefly due to the fact that measurement of precipitation is direct, whereas measurement of evaporation has been more indirect. Although many investigators have worked on the problem, using more or less empirical methods, its status is far from satisfactory. Empirical methods yield results primarily of local importance. Of recent years, however, a number of investigators have made valuable contributions to the rational solution of the problem, especially with respect to evaporation from free-water surfaces. Less has been contributed, however, on the subject of losses from soils and plants. The problem is essentially one in thermodynamics and its solution calls for careful measurements of energy and temperature changes in various parts of the system concerned. (g) Measurements will be made on the following: intensity of reception of solar energy; intensity of radiation to the sky; heat changes in the system; heat transfer to or from the air as sensible heat; conduction of heat into or out of the system. (h) Work on this project is being continued. (i) See under heading, Abstracts of Completed Projects and References to Publications, of this Bulletin for a list of reports published.

(272) (a) CHARACTERISTICS OF SPRINKLERS AND SPRINKLER SYSTEMS FOR IRRIGATION. (Part of larger project on farm irrigation structures and systems.) (b) California Agricultural Experiment Station. (c) Experimental Station Project. (d) J. E. Christianson. (e) Professor F. J. Veihmeyer. (f) Determination of factors affecting uniformity of distribution, evaporation losses, and frictional losses in pipe lines with multiple outlets. (g) Approximately 100 tests have been made on sprinklers of different makes and types to determine the distribution of water under varying conditions. Water is caught in a large number of cans (rain gages) and evaporation losses estimated from average depth caught as compared with water discharged. Effect of wind, pressure, speed of rotation of sprinkler, temperature, humidity, and various combinations of nozzles on performance of sprinklers studied. A large number of tests have been made on portable sprinkler pipe with sprinklers spaced at definite intervals to determine net pressure losses. (h) In progress. (i) See under heading, Abstracts of Completed Projects and References to Publications, of this Bulletin for list of reports published.

(667) (a) HYDROLOGY OF IRRIGATION WATER SUPPLIES IN CALIFORNIA. (b) California Agricultural Experiment Station. (c) Experiment Station Project 1108. (d) C. V. Givan, C. N. Johnston, J. E. Christiansen, F. J. Veihmeyer, M. R. Huberty, A. F. Pillsbury. (e) F. J. Veihmeyer. (f) The tremendous popular interest which has been aroused over conservation of water and soil resources is in large part based upon opinions advanced by extremists who have little substantiating data for their panaceas. Controversy between water-supply engineers, foresters, and those engaged in the production of live stock on ranges has reached the stage of emotion rather than logic. Watershed management is of vital importance to California agriculture. The results of some of the investigations of the Division of Irrigation Investigations and Practice, California Agricultural Experiment Station, notably those on evaporation of water from soils, transpiration, movement of water in the soil, and the factors that affect the water-holding capacity of soil have a direct bearing on some of the questions at issue. It is hoped that studies on typical watersheds of the State can be made by this Division because of its established program of basic research in soil-plant-water relations. (g) Field and laboratory studies are being made. (h) Experimental plots on a typical chamise-covered area in Shasta County, California, have been established. Measurements on the effect of vegetative cover on runoff and erosion have been made. Four experimental watersheds and twelve paired plots have been added to the experimental setup in northern California, and two watersheds and one pair of plots in Riverside County, southern California. Investigations are being continued. (i) See under the heading, Abstracts of Completed Projects and References to Publications, of this Bulletin for a list of reports published. At Davis, a new Irrigation Laboratory for a study of problems in connection with this project was completed in January 1941. See "New Irrigation Laboratory at Davis", Pacific Rural Press 131 (8): 308, April 19, 1941, by C. N. Johnston.

(1157) (a) PHYSICAL AND CHEMICAL FACTORS AFFECTING SOIL INFILTRATION RATES. (b) U. of C., College of Agriculture, Los Angeles. (c) Experiment Station Project. (d) M. R. Huberty, A. F. Pillsbury. (e) Prof. M. R. Huberty. (f) Study of factors affecting soil infiltration rates, primarily as to effect on irrigation practices. (g) Field plots and laboratory investigation under controlled conditions. (h) A continuing project. (i) See under heading, Abstracts of Completed Projects and References to Publications, of this Bulletin for list of publications.

CARNEGIE INSTITUTE OF TECHNOLOGY.

(1273) (a) MODEL STUDY OF THE PROPOSED NEW CUMBERLAND DAM - OHIO RIVER. (b) U. S. War Department. (c) Laboratory study of dam design. (d) E. P. Schuleen, W. J. Hopkins, H. A. Thomas, and associates. (e) Professor H. A. Thomas. (f) To determine the current conditions at the upper and lower approaches to the lock and the feasibility of different types and locations of navigable passes. (g) The general procedure will involve the determination of current directions and velocities by tracing confetti movements. The effects of the currents on tow movements will be noted by observing the path and shift of model tows for various designs of the structure. (h) The model construction is about 80% completed; thus no testing has been done as yet.

(1274) (a) CAVITATION INVESTIGATION WITH REGARD TO THE SCOUR ON BAFFLE PIERS ON THE SPILLWAY OF BONNEVILLE DAM. (b) U. S. War Department. (c) Laboratory study of model sealed in vacuum tank apparatus. (d) E. P. Schuleen, W. J. Hopkins, H. A. Thomas, and associates. (e) Professor H. A. Thomas. (f) To determine what modifications in shape, size, and location of the baffle piers on the spillway deck would be desirable in order to prevent or retard further pitting of said baffle piers and apron. (g) A model constructed on a scale of 1 to 48 and including the bucket, apron, and baffles was installed and tested in an enclosed tank under sub-atmospheric pressure to simulate properly all the forces acting in the prototype. The general procedure involved a visual inspection of the occurrence of cavitation pockets under difficult conditions, and the recording of data corresponding to the conditions observed in the model. (h) The project is approximately 80% completed.

(1275) (a) RELATIONSHIP OF CAVITATION FOUND IN THE PROTOTYPE AND BY MODEL STUDY. (b) Thesis for Master's Degree in Civil Engineering. (c) Investigation of the comparative effects of cavitation. (d) Professor H. A. Thomas and A. M. Feiler. (e) Professor H. A. Thomas. (f) To determine the intensity and relative effects of cavitation in the prototype from a scale model investigation, and the relative accuracy of such an investigation. (g) The project includes a model study of cavitation and correlation of data obtained to actual prototype conditions. The study will cover the actual effect of cavitation in the conduit of a selected high dam and a comparison of these effects with those obtained in a scale model study. using materials of varying strength to obtain results similar to the prototype conditions. (h) The project is approximately 30% complete.

UNIVERSITY OF COLORADO.

(1276) (a) FRICTION LOSSES IN FIRE HOSE. (e) Prof. C. L. Eckel.

COLORADO SCHOOL OF MINES.

(1277) (a) FLOW OF SOLIDS IN SUSPENSION IN PIPELINES. (b) Laboratory project. (c) General laboratory investigation. (d) Laboratory staff. (e) Prof. Warren E. Wilson. (f) To obtain data to facilitate design of pipelines carrying solids in suspension. (g) Pipeline with transparent section and necessary auxiliary equipment is available to study a wide range of flows and solids concentrations. (h) Theoretical investigation nearly complete. Laboratory work to begin about January 1, 1942.

UNIVERSITY OF IDAHO. (College of Engineering and Engineering Experiment Station).

(1278) (a) IDAHO DRAINAGE BASIN STUDIES. (b) Engineering Experiment Station. (c) Application of available hydrologic data to existing watershed problems. (d) J. E. Buchanan, H. L. Thompson, T. W. Macartney. (e) Prof. J. E. Buchanan. (f) To develop basic information for water utilization, flood control, and pollution abatement. (g) Correlation of precipitation and stream-flow records for St. Joe River basin and analysis of run-off characteristics as a basis for solution of flood and pollution problems. (h) Progress report on analysis of run-off characteristics being written. Pollution abatement studies in progress.

(1279) (a) RUNOFF STUDIES IN THE PACIFIC NORTHWEST. (b) Soil Conservation Service, U. S. Department of Agriculture. (c) Hydrologic research. (d) H. S. Riesbol, Mark, W. B. Watson, D. B. Krimgold. (e) Chief, Soil Conservation Service (Attention C. E. Ramser). (f) To determine the rates and amounts of runoff from small watersheds for use in design of soil and water conservation structures and practices in agricultural areas of the Pacific Northwest. (g) Measurements of runoff, precipitation, snow accumulation, air and soil temperature, air humidity, and, to a limited extent, soil moisture are being obtained from agricultural watersheds located at Moscow and Emmett, Idaho, Pullman and Dayton, Washington, and Newberg, Oregon. Maps showing details of topography and soil have been prepared for each watershed. Records of cover and tillage are placed on these maps each year. (h) Four complete years of record have been obtained from two watersheds at Moscow, Idaho, two at Emmett, Idaho, three at Pullman, Washington, and four at Newberg, Oregon. Two complete years of record have been obtained from a diversion terrace area at Dayton, Washington. Studies of watershed yield, expectancy for runoff rates, and rainfall characteristics for the Pacific Northwest have been made and published.

UNIVERSITY OF ILLINOIS

(739) (a) EFFECT OF RADIUS OF CURVATURE ON THE FLOW OF WATER AROUND PIPE BENDS. (c) Research. (e) Prof. F. B. Seely. (h) Completed. Data being analyzed.

(843) (a) A STUDY OF THE HYDRAULIC CHARACTERISTICS OF VALVES. (c) Student thesis. (e) Prof. F. B. Seely. (h) Tests nearly completed.

(1064) (a) EFFECTS OF VANES ON THE VELOCITY DISTRIBUTION IN A PIPE. (c) Research. (d) V. H. Moore; Prof. W. M. Lansford. (e) Prof. F. B. Seely. (f) To study the effect on the velocity distribution downstream from a 90° bend in a 24-inch pipe of vanes in or near the bend and to determine the loss in head caused by such vanes. (h) Tests have been completed as outlined and results are on file in the University Library.

(1065) (a) A STUDY OF TRANSLATORY WAVES IN AN OPEN CHANNEL. (c) Student thesis. (d) H. E. Romine; Prof. W. M. Lansford. (e) Prof. F. B. Seely. (g) Tests in progress.

(1066) (a) STUDY OF RELIEF VALVES. (c) Student thesis. (d) Edward Mauel; Prof. C. P. Kittredge. (e) Prof. F. B. Seely. (f) To study the hydraulic operating characteristics of two types of relief valves. (h) One series of tests completed and thesis on file in the University Library.

(1068) (a) STUDY OF TURBULENT FLOW THROUGH ANNULAR TUBES. (c) Student thesis. (d) J. R. Bishop; Prof. C. P. Kittredge. (e) Prof. F. B. Seely. (f) Loss of head and use of a Pitot tube for determining velocity distribution in annular tube having outside diameter of 6 inches. (h) Preliminary tests completed and thesis on file in University Library. Further tests in progress.

(1069) (a) HYDRAULICS OF FLOW IN WELLS. (b) Engineering Experiment Station. (c) Research. (d) H. E. Babbitt. (e) Prof. H. E. Babbitt. (f) To test existing hypotheses of flow of water into wells. (g) Observation of laboratory experiments and of wells in the field. (h) Tests in progress.

(1070) (a) RADIAL OUTWARD FLOW OF WATER BETWEEN DISKS. (b) Research. (c) Tests of fixed and movable geometrically similar disks in a range of sizes. (d) Prof. P. E. Mohn. (e) Prof. P. E. Mohn. (f) To obtain design data and experimental verification of theoretical analysis. (g) Experimental. (h) Tests in progress.

THE STATE UNIVERSITY OF IOWA.

(316) (a) HYDROLOGIC STUDIES - RALSTON CREEK WATERSHED. (b) and (c) Cooperative project - Iowa Institute of Hydraulic Research, U. S. Department of Agriculture and U. S. Geological Survey. (e) Professor J. W. Howe. (h) Continuous records since 1924 of precipitation, runoff, groundwater levels, and cover. Drainage area 3 sq miles of rolling agricultural land near east city limits of Iowa City.

(317) (a) COOPERATIVE SURFACE WATER INVESTIGATIONS IN IOWA. (b) Iowa Institute of Hydraulic Research. (c) Cooperative project with the U. S. Geological Survey. (d) U. S. Geological Survey, Water Resources Branch, and Iowa Institute staffs at Iowa City, Iowa. (e) L. C. Crawford and E. W. Lane. (f) Continuous records of stage and discharge of Iowa streams. (g) Standard methods on a state-wide basis. (h) Gaging stations are maintained cooperatively and on a continuing basis.

(844) (a) STUDY OF EVAPORATION FROM LAKE SURFACES. (b) Cooperative project, U. S. Weather Bureau, Iowa Lakeside Laboratory and Iowa Institute of Hydraulic Research. (c) Observations of evaporation under various conditions at Lake Okoboji, Iowa. (d) Staff members of cooperating parties. (e) B. S. Barnes. (f) To determine the laws governing evaporation from water surfaces of lakes under various conditions. (g) Extensive observations on evaporation and controlling hydrological conditions will be made on lakes centering around Lake Okoboji, for a wide variation of conditions such as size, depth, etc. (h) Studies are just begun, observations with standard and insulated pans at edge of Lake Okoboji under way.

(845) (a) STUDY OF HYDROLOGY OF RAPID CREEK. (b) Cooperative project - U. S. Geological Survey, U. S. Weather Bureau, and Iowa Institute of Hydraulic Research. (c) Development of index basin for vicinity of Iowa City. (d) Staffs of cooperating parties. (e) Iowa Institute of Hydraulic Research. (f) To develop the relation between rainfall and stream flow as an aid in predicting the flood flows of larger streams. (g) Measurements of stream flow, rainfall, and groundwater level will be observed and correlated. (h) Stream flow and rainfall measurements under way; groundwater observing stations not yet installed.

(846) (a) HYDROLOGIC STUDIES - BASINS OF UPPER MISSISSIPPI REGION. (b) Iowa Institute of Hydraulic Research. (c) Cooperative project - U. S. Weather Bureau. (d) B. S. Barnes, Hydrologic Supervisor, Upper Mississippi Region, and staff. (e) B. S. Barnes. (f) To determine the relation between precipitation and runoff, and particularly the form of discharge hydrograph resulting from a given rainfall, with a view to the more accurate prediction of daily river stages. (g) Study of climatological records, construction, and analysis of discharge hydrographs, especially of the smaller basins. Field studies include the obtaining of records of momentary rainfall intensities and some special evaporation experiments.

(849) (a) AN INVESTIGATION OF FISHWAYS. (b) Iowa Institute of Hydraulic Research in cooperation with Iowa Conservation Commission. (c) Library and laboratory research. (d) A. M. McLeod and Paul Nemenyi. (e) Prof. E. W. Lane. (f) To develop more effective and economical fishways. (g) (1940-1941 studies). Several models of simple design based on the Denil principle were studied for use on low dams. Full-scale studies were continued with heads up to 10 ft and with varying slope. Further data were collected on migratory habits of fish. (h) The report of the experimental studies for 1937-1939 has been published in the report of the State Conservation Commission for the biennium ending June 30, 1940. It has also been reprinted as Bulletin 24 of the University of Iowa Studies in Engineering. The bibliographic study is available as Bulletin 23 of the University of Iowa Studies in Engineering. Limiting slopes have been established during the 1940-1941 studies for one design of fishway for heads up to 10 ft. Some fairly effective and extremely simple designs were found for mild slopes by model studies. Data on migration are being collected in conjunction with the full-scale studies. (i) It is hoped to continue the full-scale studies in 1942.

(859) (a) EFFECT OF FREEBOARD UPON EVAPORATION FROM STANDARD LAND PAN. (b) Department of Mechanics and Hydraulics. (c) Master's thesis (experimental). (d) Russell W. Revell. (e) Prof. J. W. Howe. (g) Level in two land pans held constant by Marriotte flask apparatus. Both pans given same exposure but operated with different free boards. Air and water temperatures, relative humidity, wind velocity over the pan, and evaporation observed. (h) Completed. (i) Total evaporation with 2" and 3" freeboards approximately the same. However, with low wind velocity, pan with 3" freeboard had <u>less</u> evaporation, and with high wind velocity had more evaporation, than occurred in pan with but 2" freeboard. Author attributed this change in evaporation characteristics to effect of freeboard upon intensity and scale of air turbulence.

(1025) (a) STUDY OF EQUIPMENT AND TECHNIQUE FOR SUSPENDED SEDIMENT SAMPLING AND ANALYSIS. (b) U.S. Departments of War, Interior, Agriculture, Tennessee Valley Authority, and Iowa Institute of Hydraulic Research. (c) A study is being made to determine the errors resulting from present methods and equipment of sediment sampling and to devise means of reducing them. An investigation of present methods of sediment concentration and size analysis will also be carried out and the possibility of improved methods will be studied. (d) U. S. Departments of War, Interior, Agriculture, Tennessee Valley Authority, and Institute of Hydraulic Research. (e) Prof. E. W. Lane. (f) To increase accuracy and reduce cost of sediment sampling and analysis. (g) Review of present status of suspended sediment sampling equipment, field technique, and laboratory analysis, with office and laboratory studies of the errors involved and the possibility of developing improved methods and equipment. (h) Report completed on (1) present status of suspended sediment, (2) bed-load sampling equipment and technique, (3) analytical study of accuracy of sampling methods, (4) methods of size analysis of sediments, (5) laboratory investigation of suspended-sediment samplers. Several types of integrating samplers are being developed and also a method of size analysis particularly adapted to suspended sediments.

(1026) (a) TURBULENCE AND SUSPENDED MATERIAL TRANSPORTATION IN A SMALL OPEN CHANNEL. (b) Iowa Institute of Hydraulic Research. (c) Laboratory Research. (d) A. A. Kalinske and C. L. Pien. (e) A. A. Kalinske. (f) To measure the diffusion characteristics of water flowing in an open channel, and to correlate such data with observations on suspended material transportation. The channel being used is 11 inches wide, 10 inches deep, and 70 feet long. (g) The photographic technique for determining the diffusion characteristics of turbulence that was developed in Project 855 will be used in this project. Special study is to be made of the suspension near the bottom. (h) The tests are complete, and a paper is being prepared.

(1029) (a) DETERMINATION OF BEST PROPORTIONS FOR CANAL BENDS. (b) Department of Mechanics and Hydraulics. (c) Doctor's thesis (experimental). (d) Chen-Hsing Yen. (e) Prof. J. W. Howe. (f) To determine effect of different proportions of cross section upon losses in bends. (g) Experimental flume, one foot square in cross section, about 80 ft long, containing 90° bend, tested at various depths and cross-section proportions, at a uniform slope. (h) Completed. (i) Two channel shapes, of the eleven tried, resulted in a significant reduction in loss around the bend. (1) A reduction at the center of the bend of 30% in width and an increase of 30% in depth (for design discharge) gave an 11% decrease in loss around bend. This benefit decreased rapidly as discharge was reduced. (2) An increase in width of 15% at the middle of the bend, accomplished by moving the inner wall toward the center of curvature, decreased bend losses by 9%. This benefit remained essentially constant as discharge was reduced.

(1165) (a) STUDIES IN CHANNEL STABILITY. (b) The China Foundation for the Promotion of Education and Culture and the Iowa Institute of Hydraulic Research. (c) Fundamental research. (d) Dr.-Ing. Pang-Yung Ho. (e) Prof. E. W. Lane. (f) To investigate channel stability as affected by the solids load transported, by defining the limits where bed load or suspended load effects are predominant, and the particle sizes where cohesion may become important. (g) Comparisons were made of computed sediment load carried as bed and suspended load for a wide range of slopes, depths, and bed material size. A study of suspended load transportation in a rectangular flume was carried on to investigate the reliability of the suspended load formulas used to determine the relative magnitudes. An investigation was carried out of the particle sizes which produce cohesive effects. (h) Study completed.

(1167) (a) ANALYSIS OF VELOCITY FLUCTUATION DATA FOR MISSISSIPPI RIVER. (b) Iowa Institute for Hydraulic Research in cooperation with Rock Island Illinois District U. S. Engineer Office. (c) Analytical study. (d) A. A. Kalinske. (e) Prof. A. A. Kalinske. (f) To obtain quantitative data on turbulence in Mississippi River as recorded by standard current meter. (g) Data were obtained in such a manner that the time for each revolution of the current meter was recorded. This permits the obtaining of the velocity for intervals of time of the order of 1 second, and thus the fluctuation in velocity can be measured. Both the intensity and the scale of the turbulence can be obtained from the data. (h) Data near the surface, midpoint, and near the bottom have been analyzed for some six different points on the river for various flow conditions. Report in preparation.

(1280) (a) ANALYSIS OF DISCHARGE-RECESSION CURVES FOR THREE IOWA STREAMS. (b) Department of Mechanics and Hydraulics. (c) Master's thesis (analytical). (d) Julian R. Fleming. (e) Bertram S. Barnes. (f) To break down hydrograph into 3 components and to discover whether these become straight lines on semi-logarithmic paper. (g) Hydrographs from Rapid Creek (25 mi^2), Skunk River (320 $mi.^2$) and the Wapsipinicon River (2300 $mi.^2$) plotted on semi-log paper. (h) Completed. (i) Rapid Creek flow breaks into 3 components, each of which has essentially constant mathematical characteristics. The same method of analysis seems to apply to the larger streams with equal force.

(1282) (a) RELATION OF SEDIMENT CHARACTERISTICS TO BED EROSION. (b) Institute of Hydraulic Research. (c) Laboratory investigation. (d) M. D. Dubrow. (e) Prof. H. Rouse. (f) To evaluate the general relationship between geometric and kinematic parameters of flow and the mean size and grading of the bed material for an arbitrary condition of scour. (g) Experiments conducted in glass-walled flume 1 foot wide and 2 feet deep, containing sluice gate, apron, depth control at downstream end, and measuring weir. Arbitrary geometrical proportions are kept constant during all runs, the sole variables being the rate of flow, the mean diameter, and the standard deviation of the sediment, and the time and depth of scour. (h) Control studies have been made on two uniform sands of different sizes, and tests on mixtures are now in progress.

(1285) (a) REVIEW OF LITERATURE ON FLUVIAL MORPHOLOGY. (b) Iowa Institute of Hydraulic Research. (d) Paul Nemenyi. (e) Dr. Paul Nemenyi. (f) To bring together the abstracts of the principal articles of value from fields outside of engineering. (h) Abstracts nearly completed and under preparation for publication.

(507) (a) THE CONVERSION OF KINETIC INTO POTENTIAL ENERGY. (b) Iowa Institute of Hydraulic Research in cooperation with the Am. Soc. C. E. Committee on Hydraulic Research. (c) Independent research. (d) A. A. Kalinske. (e) Prof. A. A. Kalinske. (f) To investigate the basic physical phenomena of flow in divergent conduits with particular reference to the conversion of energy. (h) Analysis of laboratory experiments is finished. Report will be ready during the coming year.

(743) (a) SIMULTANEOUS FLOW OF AIR AND WATER IN CLOSED CONDUITS. (b) Iowa Institute of Hydraulic Research in cooperation with Committee on Hydraulic Research, American Society of Civil Engineers. (c) Laboratory research. (d) A. A. Kalinske. (e) Dean F. M. Dawson. (f) To obtain data on the flow of water in partly full conduits when air is being dragged along, when the air is flowing faster than the water, and when the air flows counter to the direction of the water. (g) Rectangular closed conduits 8"x7" & 8"x15",50 feet long, are used with transparent sides. Provisions for air-flow measurement are made at both ends of the conduit. Surface friction between the air and the water is one of the important items being investigated. (h) Tests are now being made with special emphasis on wave formation at the air-water interface.

(1030) (a) SEDIMENT BEHAVIOR IN UPWARD FLOW. (h) Results published under title "Suspension of Sediment in Upward Flow", by Hunter Rouse, in Bulletin 26 of the University of Iowa Studies in Engineering, December 1941.

(1031) (a) (STRUCTURAL) TESTS OF FLUME CORNERS. (b) Department of Civil Engineering. (c) Research, including Master's thesis. (d) Prof. C. J. Posey and D. Sagues. (e) Prof. C. J. Posey. (f) To test further improvements on design of flume corners suggested by results of project (1031, 1941 report). (g) Tension tests of knees as in previous investigations, but with different reinforcing systems. (h) Nearly completed. (i) Results will be published together with those of project (1031, 1941 report).

(1032) (a) EFFECTS OF CERTAIN FLUID PROPERTIES UPON THE PROFILE OF THE HYDRAULIC JUMP. (b) Department of Mechanics and Hydraulics. (c) Master's thesis. (d) Prof. C. J. Posey, M. D. Dubrow, J. C. Goodrum. (e) Prof. C. J. Posey. (f) To study effect of viscosity and surface tension on the profile of the jump. (g) Various fluids in recirculating hydraulic demonstration table. (h) Completed. (i) Results not well defined: apparently surface tension and viscosity have little effect on the jump profile. An incidental result of the project was the observation that the so-called "undular" form of the jump is due to side eddies in the flow upstream from the jump rather than any inherent quality of low jumps. Low jumps can form without undulations if these eddies are eliminated.

(1166) (a) ENTRAINMENT OF AIR IN PIPES BY FLOWING WATER. (b) Iowa Institute of Hydraulic Research in cooperation with Waldo Smith Fellowship Committee of American Society of Civil Engineers. (c)Laboratory research and Master's thesis. (d) Percy Bliss. (e) Prof. A. A. Kalinske. (f) To determine the conditions necessitating use of air valves on water pipe lines and obtain data for determining their size and location. (g) Tests will be made on various sizes of pipes placed at different slopes. Transparent pipes will be used to permit photographing the phenomena. (h) Tests on air entrainment by a hydraulic jump in a 6-inch pipe have been finished. Other phases of the project are being continued. A preliminary report is soon to be published.

(1168) (a) EFFECT OF EXCESS TURBULENCE ON PRESSURE DROP IN STRAIGHT PIPES, PIPE FITTINGS, AND VARIOUS CONTROL APPARATUS. (b) Iowa Institute of Hydraulic Research. (c) Laboratory research. (d) A. A. Kalinske. (e) Prof. A. A. Kalinske. (f) To obtain quantitative data on the turbulence and to determine its effect on the friction loss in straight pipes and various fittings and control apparatus, such as elbows, reducers, expansions, valves, etc. (g) The excess turbulence will at first be induced by grids and screens in order that its intensity and scale may be properly controlled. Photographic study will be made in order to obtain a measure of the turbulence and to observe the phenomena of decaying turbulence in general. (h) Laboratory apparatus is being designed. Data obtained in wind-tunnel work on effect of turbulence on drag of bodies have been investigated.

(1169) (a) CHEZY'S "C" IN A RECTANGULAR FLUME WITH DEFINITE ARTIFICIAL ROUGHNESS. (b) Iowa Institute of Hydraulic Research and Ralph W. Powell of the Ohio State University. (c) Research. (d) Ralph W. Powell. (e) Prof. Ralph W. Powell. (f) To find how "C" varies with the size and spacing of roughness elements, and with the other factors involved. (g) Measurements made in an 8 inch flume 50 feet long, at depths of from 1 to 5 inches, and slopes of 0.0005, 0.002, 0.008, and 0.031. Roughness elements are 1/8 in. and 1/4 in. square, spaced 2-1/2 in., 5 in., 10 in., and 20 in. apart, in various combinations. (h) Measurements completed. Computations in progress.

(1281) (a) EFFECT OF AERATION RATES UPON DISCHARGE OVER A SHARP-CRESTED SUPPRESSED WEIR. (b) Department of Mechanics and Hydraulics. (c) Master's thesis (experimental). (d) Claud C. Lomax. (e) Prof. J. W. Howe. (f) (1) To determine the effect upon discharge over weir of negative pressure under the nappe; (2) To determine air demand of nappe under various tailwater and pressure conditions. (g) Experimental weir 30 inches long installed in glass-walled flume. Quantities up to 10 cfs used. Air demand measured by orifices mounted on box admitting to region under nappe, the box being equipped with differential draft gage for pressure measurements. (h) Experimental work about finished.

(1283) (a) SUPERCRITICAL FLOW IN OPEN-CHANNEL TRANSITIONS. (b) Iowa Institute of Hydraulic Research in cooperation with the Committee on Hydraulic Research, Hydraulics Division, American Society of Civil Engineers. (c) Analytical and experimental investigation. (d) B. V. Bhoota, H. Rouse. (e) Prof. H. Rouse. (f) To determine principles of design for divergent and convergent canal sections carrying high-velocity flow. (g) Experimental apparatus consists of supply lines with elbow meters of 5 cfs capacity; 2.5' x 5' pressure tank, interchangeable nozzles delivering parallel high-velocity flow at effectively six different width-depth ratios; 5' x 8' adjustable floor equipped with piezometers and point-gage carriage; adjustable vertical boundaries equipped with piezometers. Initial variables include depth and velocity of flow, width-depth ratio, and boundary form; effects of slope and roughness may later be introduced. Analysis will seek to evaluate non-uniformity of flow through principles of wave propagation. (h) Project organized October, 1941; experimental apparatus to be in operation by January, 1942.

(1284) (a) FLOW IN A NARROWING TRANSITION IN A RECTANGULAR CHANNEL. (b) Department of Mechanics and Hydraulics. (c) Master's thesis. (d) C. J. Posey, G. B. Lyon. (e) Prof. C. J. Posey. (f) To study flow in simple straight-line rectangular transition. To determine whether such a transition, without a throat, can act as a control. (g) Experimental, in special one-foot flume. (h) Experimental work nearly completed.

(1286) (a) THE EFFECT OF SHAPE ON PARTICLE TRANSPORTATION IN FLUMES. (b) Research conducted under a Guggenheim Fellowship. (c) A study of the effects of particle sphericity and roundness during bed-load transportation in flumes. (d) W. C. Krumbein, visiting Research Associate from the Department of Geology, University of Chicago. (e) W. C. Krumbein, Dept. of Geology, University of Chicago, Chicago, Illinois. (f) The study is designed to bring out the geological implications of the shape factor, rather than to explore the subject fully from the viewpoint of fluid mechanics. (g) The behavior of artificial particles of known sphericity under varying values of the Froude number. The investigation includes only smooth flume traction. (h) Experimental work essentially finished.

(851) (a) HYDRAULICS OF VERTICAL DRAIN AND OVERFLOW PIPES. (b) Iowa Institute of Hydraulic Research in cooperation with the National Association of Master Plumbers. (c) Laboratory Research. (d) A. A. Kalinske. (e) Dean F. M. Dawson or A. A. Kalinske. (f) To determine head-discharge relationship for various sizes and lengths of vertical drain pipes and overflow pipes which do not flow full. Air flow measurements are also made. (g) An apparatus has been constructed which will insure radial flow into pipes of diameters ranging from 6 inches to one inch. (h) A paper summarizing the results is being published in a University bulletin giving a report on research at the Institute during 1940-41.

(853) (a) AIR-CHAMBERS FOR WATER-HAMMER RELIEF. (b) Iowa Institute of Hydraulic Research in cooperation with the National Association of Master Plumbers. (c) Laboratory research. (d) A. A. Kalinske. (e) Prof. A. A. Kalinske or Dean F. M. Dawson. (f) To determine a relation between water velocity, pipe size, air-chamber volume, length of pipe, and water-hammer pressure-reduction. (g) All the variables mentioned in (f) are being varied for a simple straight pipe. In addition, the effect of a restriction between the pipe and air-chamber is being studied. (h) Tests have been finished and results are being analyzed.

(1027) (a) INVESTIGATION OF OPERATION OF GREASE INTERCEPTORS AND OTHER LIQUID SEPARATORS. (b) Iowa Institute of Hydraulic Research in cooperation with the National Association of Master Plumbers. (c) Laboratory research. (d) Dean F. M. Dawson, A. A. Kalinske, A. M. McLeod. (e) Dean F. M. Dawson. (f) To determine the basic principles of separation of mixed liquids having different densities. (g) Tests are being made on various types of commercial grease interceptors. A more fundamental study is to be made on the effect of baffles, water turbulence, and water velocity on the carrying of particles lighter than water, such as the grease and oils which ordinarily enter interceptors. (h) A standard method for testing grease interceptors is being developed.

(1028) (a) DESIGN OF WATER-SUPPLY SYSTEMS FOR BUILDINGS. (b) Iowa Institute of Hydraulic Research in cooperation with the National Association of Master Plumbers. (c) Library and laboratory investigation. (d) Dean F. M. Dawson and A. A. Kalinske. (e) Dean F. M. Dawson. (f) and (g) To compile and organize all existing data on friction loss in iron, lead, and copper pipe, and for all types of fittings and plumbing fixtures. These data are to be used in developing simplified methods of water-piping sizing for plumbing systems. Laboratory tests will be made on those fittings or fixtures for which data are not available. (h) The report is finished and will be published soon as Bulletin No. 3 by the National Association of Master Plumbers.

(109) (a) INVESTIGATION OF LOCK HYDRAULIC SYSTEMS. (b) Corps of Engineers, U. S. Army, St. Paul District. (c) Design project. (d) U. S. Engineer Department staff. (e) Martin E. Nelson, Engineer. (f) To eliminate as many as possible of the features now found to be unsatisfactory in river navigation locks and to increase the efficiency of the hydraulic systems of such locks. (g) A typical barge lock was constructed 1/15th prototype size and was subsequently altered to conform to changes indicated by tests. (h) A final report is being prepared.

(861) (a) MISSISSIPPI RIVER, FILLING AND EMPTYING SYSTEM FOR NEW LOCK NO. 2, HASTINGS, MINN. (b) Corps of Engineers, U. S. Army, St. Paul District. (c) Design project. (d) U. S. Engineer Department staff. (e) Martin E. Nelson, Engineer. (f) To develop a satisfactory system to fill and empty the lock, employing short culverts around the lock gates. (g) Tests were conducted in a model on a scale of 1 to 30, observations were made with respect to turbulence, surging, hawser pull, and duration of lockage. (h) The final report is being prepared.

(1035) (a) PROTOTYPE LOCK HYDRAULICS TESTS TO VERIFY MODEL EXPERIMENTS. (b) Corps of Engineers, U. S. Army, Ohio River Division. (d) U. S. Engineer Department staff. (e) Martin E. Nelson, Engineer. (f) To obtain data on the filling and emptying characteristics of navigation locks in the Ohio River Division and to observe navigation conditions in the lock approaches and flow conditions in dam stilling basins for comparison with similar model and prototype data. (g) Rates of filling and emptying and pressure changes in culverts and ports were observed on special pneumatic manometers. Velocities at the lock-chamber ends of lock-chamber and discharge ports were measured by means of a pitot bar. Tests were made at several locks in the Tennessee and Ohio Rivers. (h) The final report is being assembled for publication.

(1036) (a) DISCHARGE COEFFICIENTS FOR OBSTRUCTIONS TO SUPER-FLOOD FLOWS. (b) Corps of Engineers, U. S. Army, Rock Island District. (c) Design project. (d) U. S. Engineer Department staff. (e) Martin E. Nelson, Engineer. (f) To evaluate the obstruction offered to super-flood flows by bridges, dams, river walls, and other contractions in river channels. (g) A generalized model of a river reach with a tributary was constructed 1/120th prototype size. A number of bridges of various types were installed in the model and tested at depth submerging the decks. City conditions were simulated on the overbank areas. (h) The final report is completed. See abstract in this bulletin.

(1037) (a) MISSISSIPPI RIVER, NAVIGATION CONDITIONS IN UPSTREAM APPROACH TO L/D No. 6, TREMPEALEAU, WISCONSIN. (b) Corps of Engineers, U. S. Army, St. Paul District. (c) Design project. (d) U. S. Engineer Department staff. (e) Martin E Nelson, Engineer. (f) To determine what corrective measures can be used economically and effectively to eliminate hazardous currents in the upstream lock approach channel and to prevent excessive scour now taking place at the upstream end of the river wall of the auxiliary lock. (g) Tests were conducted on a model 1/80th prototype size simulating a reach of the Mississippi River with lock and dam No. 6 at the downstream end. (h) Tests have been completed. A final report is being prepared.

(1287) (a) HYDRAULIC SYSTEM FOR NEW FIRST LOCK, ST. MARY'S FALLS CANAL, SAULT STE MARIE, MICHIGAN. (b) Corps of Engineers, U. S. Army, Detroit District. (c) Design project. (d) U. S. Engineer Department staff. (e) Martin E. Nelson, Engineer. (f) To develop a satisfactory system to fill and empty the lock, employing a system with culverts in the side wall, laterals below the lock floor, and vertical lock chamber ports. (g) Tests are being conducted in a model on a scale of 1 to 25, and observations are being made with respect to turbulence, surging, hawser pull, and duration of lockage. (h) Design and construction of the model have been completed. The testing program is in progress.

THE JOHNS HOPKINS UNIVERSITY.

(1288) (a) INVESTIGATION OF THE DISCHARGE COEFFICIENTS OF THE 90-DEGREE V-NOTCH WEIR WHEN USED FOR MEASURING WATER. (d) Prof. F. W. Medaugh. (e) Prof. F. W. Medaugh. (g) Heads are read to tenths of millimeters by using a point gage, a plane-table alidade, and a light with a reflector. Zero reading was obtained by lowering front point gage until it touched point of V and then setting both point gages even with the water surface in a wide shallow pan suspended in the weir box. Water reached the weir from circular orifices discharging under constant heads. Heads on the weir as high as nine-tenths of a foot were used. (h) The work is about completed and will probably be available in printed form by January 1st, 1942.

LAFAYETTE COLLEGE.

(1289) (a) WIND VELOCITIES AT VARIOUS ELEVATIONS OVER WATER. (b) There is no commercial or industrial connection. The project is pure research on the part of the college laboratory. (c) 1. To measure the wind velocity at a number of different elevations above the water to determine the effect of the wind dragging on the water. Thus, to determine a coefficient that will indicate the part of the wind energy that is lost owing to friction of the water. 2. This energy which the wind loses when it passes over water is (a) lost owing to friction, (b) builds up wave height and (c) wave velocity; the project is to determine the quantitative values of these three for any wind velocity. (d) (e) Lynn Perry, Associate Professor of Civil Engineering. (f) Contribution to technical knowledge. (g) c-1. Above is complete. It will require considerable field observation to obtain sufficient data for the remainder. The investigator can do it all unless his time is required on other work. (h) c-1. Above is complete. (Field work) and computations.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY (Department of Civil and Sanitary Engineering, River Hydraulic Laboratory.)

(1172) (a) AN EXPERIMENTAL INVESTIGATION OF THE EFFECT OF VARIATIONS OF REYNOLDS NUMBER UPON THE COEFFICIENT OF FRICTION IN OPEN-CHANNEL FLOW. (b) River Hydraulic Laboratory, M.I.T. (c) Bachelor's thesis. (d) E. F. Smith. (e) Prof. K. C. Reynolds. (f) See (a). (g) A channel of triangular cross-section was used, having varnished walls. (h) This phase of the research completed. 1941 thesis on file. For title, see (a).

(1173) (a) AN EXPERIMENTAL INVESTIGATION FOR THE DETERMINATION OF THE VARIATION OF FRICTION FACTOR "f" WITH REYNOLDS' NUMBER "R" FOR THE UNIFORM FLOW OF WATER IN OPEN CHANNELS. (b) River Hydraulic Laboratory. (c) Master's thesis. (d) M. F. Bebe. (e) Prof. K. C. Reynolds. (f) See (a). (g) A tilting wooden channel was used, 38 ft long and of rectangular cross-section. The walls and bottom were artificially roughened with sand. (h) Research completed 1941. Thesis on file. For title, see (a). Theses may be loaned to responsible parties for two weeks.

(1290) (a) AN INVESTIGATION OF THE PRESSURE EXERTED ON CAISSONS AND PIERS BY THE FLOW OF WATER PAST THE CAISSON OR PIER. (b) River Hydraulic Laboratory. (c) Master's thesis. (d) L. J. Skowronek. (e) Prof. K. C. Reynolds. (f) See (a). (g) Models were made of several types of caissons and piers. As water flowed past the caissons, observations were made of the pressure exerted. The angle of attack and velocity were varied. (h) Research completed. 1941 thesis on file. For title, see (a).

(1291) (a) MODEL STUDY OF A SPILLWAY PROFILE. (b) River Hydraulic Laboratory. (c) Bachelor's thesis. (d) W. E. Carren, Jr. (e) Prof. K. C. Reynolds, (f) See (a). (g) A model of a dam was built with no spillway face and the profile of the overflowing nappe was determined under atmospheric pressure conditions. A complete model of a dam was built whose downstream face fitted the profile thus determined. Pressure observations indicated no pressure for the designed head. (h) Research completed. 1941 thesis on file. For title, see (a).

(1292) (a) AN EXPERIMENTAL STUDY OF FLOW THROUGH MODELS OF THE MARKED TREE SIPHON. (b) River Hydraulic Laboratory. (c) Bachelor's thesis. (d) R. A. Markey, Jr. (e) Prof. K. C. Reynolds. (f) See (a). (g) Three models, each to a different scale, were available. The discharge coefficients of each model were determined under different heads, and pressure observations were made of the largest model. (h) Research completed. 1941 thesis on file. For title, see (a).

UNIVERSITY OF MINNESOTA (St. Anthony Falls Hydraulic Laboratory)

(94) (a) TRANSPORTATION OF SEDIMENT. (c) University hydraulics research project. (e) Prof. Lorenz G. Straub. (b), (d), (f) and (g) (Details given in earlier bulletins.)

(190) (a) FLOW CONDITIONS IN OPEN CHANNEL. (c) University hydraulics research project. (e) Prof. Lorenz G. Straub. (b), (d), (f), (g) and (i) (Details given in earlier bulletins.)

(676) (a) FRICTION LOSS IN PLUMBING-SYSTEM PIPE LINES. (c) Cooperative research project with the Sanitary Division of the Minnesota State Board of Health and the Hydraulics Department of the University of Minnesota. (e) Prof. Lorenz G. Straub. (b), (d), (f) and (g) (Details given in earlier bulletins.)

(677) (a) SEDIMENTATION AT THE CONFLUENCE OF RIVERS. (c) In cooperation with the Committee on Hydraulic Research of the American Society of Civil Engineers. (e) Prof. Lorenz G. Straub. (b), (d), (f), (g) and (i) (Details given in earlier bulletins.)

(679) (a) STABILITY OF SAND DAMS. (b) Project continued in cooperation with Committee on Seepage and Erosion of the American Society of Civil Engineers. (e) Prof. Lorenz G. Straub. (d), (f) and (g) (Details given in earlier bulletins.)

(985) (a) HIGH-VELOCITY FLOW IN OPEN CHANNELS. (b) Project continued in cooperation with Committee on Hydraulic Research of the American Society of Civil Engineers. (e) Prof. Lorenz G. Straub. (d), (f), and (g) (Details given in earlier bulletins.) (h) A progress report of the experimental work has been prepared.

(1061) (a) STUDY OF FLUID TURBULENCE AS RELATED TO SEDIMENT TRANSPORTATION. (c) An experimental study of the mode of transportation of sedimentary material under idealized conditions. (e) Prof. Lorenz G. Straub. (b), (d), (f) and (g). (Details given in earlier bulletins.) (h) A report is in preparation.

(1062) (a) COMPARISON OF FLOW CONDITIONS THROUGH CHANNEL CONTRACTION WORKS WITH MOVABLE AND FIXED BEDS, RESPECTIVELY. (c) The equilibrium conditions of rigid bed and movable bed channels are being studied at channel contraction works by means of a laboratory set-up. (e) Prof. Lorenz G. Straub. (b), (d), (f) and (g) (Details given in earlier bulletin.) (h) A report has been prepared as a thesis subject.

NEW YORK UNIVERSITY

(881) (a) FREE OUTFALL FROM CIRCULAR CONDUITS. (b) New York University. (c) Master's thesis. (d) J. C. Morgan. (e) Prof. J. K. Vennard. (f) To obtain the characteristics of jet trajectory, drop-down curves, etc., for use in the design of leaping weirs, and with a view toward using the outfall as a metering device. (g) Laboratory measurements using 4" to 12" transite pipes, with flows up to 2.0 cfs. (h) All experimental work completed and results being analyzed and correlated.

(1008) (a) A STUDY OF SHARP-EDGED ORIFICES. (b) New York University. (c) Undergraduate thesis. (e) Prof. J. K. Vennard. (f) To obtain complete and non-dimensional data on orifice coefficients. (g) Experimental measurements of coefficients for orifices from 0.045" to 3" diam. operating under heads from zero to 5 ft. (h) Project temporarily inactive.

(1009) (a) A STUDY OF THE MANNING "n" IN VARIED FLOW. (b) New York University. (c) Master's thesis. (d) T. J. Driscoll. (e) Prof. J. K. Vennard. (f) To observe the variation of "n" with velocity and hydraulic radius in varied flow. (g) Laboratory measurements in 4" to 12" transite pipes flowing partially full. (h) All experimental work completed and results being analyzed and correlated.

(1010) (a) A STUDY OF SIDE-CHANNEL WEIRS. (b) New York University. (c) Master's thesis. (d) J. K. Vennard. (e) Prof. J. K. Vennard. (f) To obtain a general equation for side-channel weirs. (h) Equipment completed. Tests should begin January 1942.

(1178) (a) A STUDY OF APRONS FOR DROP STRUCTURES. (b) New York University. (c) Master's thesis. (d) R. D. Ley and W. P. Comstock, Jr. (e) Prof. J. K. Vennard. (f) To study the effects of different apron curvatures on submerged and free discharge conditions, types of hydraulic jump, etc. (g) Tests with various aprons of parabolic shape with different discharges, drops, and tailwater elevations. A record of results and effects to be obtained photographically and presented mathematically if possible. (h) Test program about finished.

(1293) (a) A STUDY OF MANIFOLD PIPES. (b) New York University. (c) Bachelor's thesis. (d) M. Feldmann. (e) Prof. J. K. Vennard. (f) To compare action with theory and to compare the action of pipes with slits to those with orifices. (g) Pipes 1/2" to 2", slits 33" long and as narrow as possible. Measurements of distribution of flow from the slits and pressure variation in pipe. (h) Above tests completed. Tests with wider slits and orifices to be tested next.

(1294) (a) STUDY OF ELECTRO-DEPOSITION OF METALS ON VARIOUS SHAPED ELECTRODES FROM A FLOWING ELECTROLYTE. (b) As research for the Master's degree in Chemical Engineering. (c) The project has for its purpose to add to our knowledge of the flow of fluids on one hand and the influence on the distribution of metal around various shaped electrodes. (d) Investigators: H. J. Masson, M. Russo, F. Melaccio. (e) Prof. H. J. Masson. (f) It has been found, from previous investigations, that there is a relationship between the thickness of the deposit at various parts of the cathode and Reynold's number. It is hoped to be able to throw some light on the flow of fluids about such shapes as that of a boat or an airplane by this type of investigation, as contrasted with the towing basin or wind tunnel. (g) In previous investigations, the electrolyte has been circulated past the cathode by means of a pump. In this particular investigation, the cathode is set at the end of an arm which rotates from a shaft through the electrolyte. It has been found that this method is more sensitive for low velocities than pumping. (h) Apparatus has been designed and been in operation to supply about 25% of the data expected. (i) Investigation will be completed about the first of May 1942.

UNIVERSITY OF OKLAHOMA

(1295) (a) RESEARCH ON POSITIVE DISPLACEMENT METERS FOR VISCOUS LIQUIDS. (b) Determine factors for use in commercial measurements of petroleum products. (c) Cooperative research project sponsored by the Special Research Committee on Fluid Meters of the American Society of Mechanical Engineers. (d) Ellis M. Sims and Lowell E. Haas. (e) Lowell E. Haas.

(f) To determine accuracy, viscosity correction, pressure correction, and rate of wear characteristics for positive displacement meters (g) Meter registration is checked against weigh-tank reading. Thirty meters tested at flow rates up to 125% rated capacity or 500 gpm maximum. Four oils to be used at 4 different temperatures. (h) Two series of runs on two oils completed while the third series is well under way.

UNIVERSITY OF PENNSYLVANIA

(1014) (a) EFFECT OF INSTALLATION ON COEFFICIENTS OF VENTURI METERS. (b) A.S.M.E. Fluid Meter Committee. (c) 8" Venturi meters are placed at varying distances from elbows, enlargers, reducers, and sudden enlargements, and the coefficients determined. (d) W. S. Pardoe. (e) Prof. W. S. Pardoe. (f) To determine magnitude of effects. (g) About 150 tests. (h) Half reported in Transactions, A.S.M.E., November 1936 and November 1937. (i) Most of remaining work completed.

(1184) (a) EFFECT OF RATIOS ON COEFFICIENTS OF VENTURI METERS. (b) For W. S. Pardoe's information. (c) A 4" diameter throat was placed in 5", 6", 7", 8", 10", 12" pipes and coefficients determined. (d) W. S. Pardoe. (e) Prof. W. S. Pardoe. (f) Largely to check his theoretically derived expression for this effect. (g) Six tests with cones made of copper; after each test the copper surface was covered with sand and retested. (h) Finished. (i) Did not check formula.

(1185) (a) EFFECT OF AMBIENT TEMPERATURE ON COEFFICIENTS OF VENTURI METERS. (b) For W. S. Pardoe's information and education. (c) An 8"x3-3/8" bronze venturi meter was tested in air and then surrounded with water of same temperature as that passing through the meter, and the difference in coefficient noted. (d) W. S. Pardoe. (e) Prof. W. S. Pardoe. (f) To try and make Reynolds Number behave. (g) An A.S.M.E. Flow Nozzle and a pipe orifice showed the same effect. (h) Completed; published in Transactions, A.S.M.E., July 1941. (i) It would appear that the ambient temperature effect cannot be neglected on the curved part of the coefficient curve.

PENNSYLVANIA WATER & POWER COMPANY (Holtwood Hydraulic Laboratory.)

(1296) (a) EFFECT OF HEIGHT OF MOODY DRAFT TUBE CONE UPON POWER AND EFFICIENCY CHARACTERISTICS OF FRANCIS TYPE TURBINES. (b) Pennsylvania Water & Power Company. (c) Commercial. (d) J. E. Allen and L. M. Davis. (e) J. M. Mousson. (f) To obtain maximum power without impairing efficiency characteristics of Nos. 9 and 10 Units at the Holtwood Electric Power Plant. (g) Testing of runner model with intake, draft tube and draft tube cones of different heights. (h) Tests completed.

STANFORD UNIVERSITY

(1019) (a) STEEP SLOPE FLOW PHENOMENA. (b) Research. (c) Research (d) J. Hedberg. (e) Prof. J. Hedberg. (f) To study the energy transformation involved. (g) A redwood channel 9 inches wide and 40 feet long has been used on a 25% slope with various surface roughnesses. A new channel 3 inches wide and 110 feet long is now being constructed. (h) A number of surface profiles have been obtained, and these are being studied. (i) A progress report will be made to the American Geophysical Union in January 1942.

(1020) (a) FLOW OF FLUIDS IN FRACTIONATING COLUMNS. (b) Standard Oil Company of California. (c) Research. (d) R. E. Scherrer. (e) Prof. J. Hedberg. (f) To find how much liquid in droplet form is carried through the vapor risers for various spacings of the trays. (g) A full-scale reproduction of 1/4 of two trays is fitted with sets of bubble caps. Air bubbling through water simulates operating conditions. (h) Now in construction stages. (i) This is the third year of work on the project. In the first, valuable design data were obtained on pressure variations and flow gradients. In the second, ranges of instability of flow were isolated.

(1297) (a) WIND PRESSURES ON SIDES AND TOP OF CYLINDRICAL TANKS. (b) Research. (c) Research. (d) Prof. A. C. Bardin. (e) Prof. J. Hedberg. (f) A thesis. (g) A cylindrical tank of adjustable height was fitted with pressure leads and submerged in controlled water flow. (h) Data now being analyzed.

UNIVERSITY OF TEXAS.

(1186) (a) A LABORATORY STUDY OF HYDRAULIC NETWORKS. (b) Bureau of Engineering Research and Department of Civil Engineering at The University of Texas. (d) Quintin B. Graves. (e) Prof. S. P. Finch. (f) To check with the Hardy Cross method of analysis and to investigate certain unusual factors which have arisen. (h) The experimental work for the first network of constant diameter pipe is completed and the second network of constant but larger diameter is ready for the experimental work.

UNIVERSITY OF WISCONSIN

(764) (a) EFFECT OF VISCOSITY AND SURFACE TENSION ON V-NOTCH WEIR COEFFICIENTS. (c) Ph. D. thesis. (e) Prof. Arno T. Lenz. (h) Project completed. Ph. D. thesis on file in the library of the University of Wisconsin. A paper on this study has been accepted and edited for publication in A.S.C.E. Proceedings.

(768) (a) STANDARD WEIR AND ORIFICE STUDIES. (c) Departmental research project in cooperation with the Graduate School. (d) Mr. James R. Villemonte (now at Pennsylvania State College). (e) Prof. J. G. Woodburn. (f) Study of measurement of flow of water by means of rectangular weirs and orifices without end contractions. (h) A paper is being prepared showing accuracy of standard weir formulas for weirs 10 in., 1 ft, and 2 ft high in channels 1 ft and 2 ft wide. M.S. thesis covering the work on rectangular orifices is on file in the University of Wisconsin Library.

(1022) (a) FLOW OF LIQUIDS IN OPEN CHANNELS. (c) Ph. D. thesis. (d) Mr. E. R. Dodge. (e) Prof. J. G. Woodburn. (f) To investigate the physical nature and the applicability of empirical formulas for flow in open channels. (h) Thesis covering this investigation is in final stages of preparation. The similarity between coefficients and formulas for open channels and pipes has been substantiated for liquids of different viscosities. The tests showed definitely that the roughness coefficient for a given channel varies with slope of channel and with the hydraulic radius.

(1298) (a) DISCHARGE OF CIRCULAR ORIFICES AND WEIRS IN END OF PIPES. (c) Departmental research. (d) M.C.Ree, F. A. Bertle, R. L. Pentzien. (e) Prof. J. G. Woodburn. (f) To develop a reliable field method of measuring discharge from the ends of pipes under low head, as for instance, effluent pipes from sewage treatment plants. Measurement will be made of coefficients of discharge of (a) circular sharp-edged orifices in the end of pipes from 8 to 18 in. in diameter, the diameters of orifices being 1/4, 1/2, and 2/3 the diameter of pipe; and (b) the same orifices when the head is so low that flow through the orifice has a free surface. The orifice plates will be attached to the outer end of sleeves 8 in. long which are inserted into the end of the pipe. (h) The first tests are being made with 3-in., 6-in., and 8-in. orifices in the end of a 12-in. pipe, with heads up to 2 ft. (i) This work will form the basis of two senior theses.

(1299) (a) MODEL STUDY OF DISCHARGE CAPACITY OF KNOWLTON DAM. (b) Departmental research in cooperation with Consolidated Water Power and Paper Company and U. S. Geological Survey. (c) Senior thesis project. (d) G. D. Eklund, A. G. Ingersoll, W. W. Warzyn. (e) Prof. A. T. Lenz. (f) To determine by model tests the discharge capacity of spillway gates on dam now under construction in order that the river flow may be estimated after the dam is built. This flow data will replace that now being obtained at the U.S.G.S. Knowlton gage just upstream from the dam. (g) A 1:30 scale model will be constructed of several gates and discharge coefficients will be obtained with varying conditions of number of gates open, size of opening, and headwater elevation. (h) Plans are in preparation.

(1300) (a) FREQUENCY STUDIES OF WISCONSIN FLOODS. (c) Senior thesis project. (d) P. C. Sodemann, J. O. Wagner. (e) Prof. A. T. Lenz. (f) To determine the probability of high runoff rates in Wisconsin, making use of recent record floods. (g) Computations will be made using methods outlined in U.S.G.S. - W.S.P. 771. (h) Records are being collected.

(1301) (a) INFILTRATION TESTS ON WISCONSIN SOILS. (c) Senior thesis project, (d) C.C.Fisk, S. Resnick. (e) Prof. A. T. Lenz. (f) To determine the effect on infiltration capacity of height of water table and of head of standing water on the ground surface. (g) Soil samples will be subjected to sprinkling tests in the laboratory where groundwater and surface water levels can be controlled. (h) Apparatus under construction.

WORCESTER POLYTECHNIC INSTITUTE.

(1188) (a) MODEL STUDY OF NORTHAMPTON PUMPING PLANT. (b) U. S. Engineer Office, Providence District, Lt. Col. J. S. Bragdon, District Engineer. (c) Check of design. (d) L. J. Hooper and J. Hamer. (e) Prof. C. M. Allen. (f) To determine the flow conditions past and over a side channel spillway. (g) a 1:10 model was built of the project, comprising the substructure or basement of the plant. (h) Work completed. Report on file at Engineers Office.

(1189) (a) MILL RIVER CONDUIT. (b), (c), (d) and (e) as in (1188). (f) To determine the flow conditions throughout the length of the conduit when flowing part full. (g) A 1:60 model of the conduit was built of wood and galvanized iron. The grade and bottom half of the shape of the conduit were reproduced, but the side walls were continued above the top elevation of the conduit, and the top was left off so that the wave formations could be observed. (h) Work completed. Report on file at Engineers Office.

(1190) (a) MILL RIVER CONDUIT ENTRANCE. (b), (c), (d), and (e) as in (1188). (f) To determine the capacity and the drop-down curve of the water surface at the entrance to the conduit for various flow conditions. (g) The 1:20 model of the entrance and a section of the conduit thereafter was constructed of galvanized iron and wood. The discharge was measured with an 8" x 4" meter and water surface elevations with a point gage. (h) Work completed. Report on file at Engineers Office.

(1193) (a) PARK RIVER CONDUIT ENTRANCE. (b), (c), (d) and (e) as in (1188). (f) To study the flow conditions at the entrance to the Park River Conduit. (g) A 1:30 model to the entrance was constructed of lucite. The flow conditions in the approach channel and within the conduit were studied for a variety of head-water and back-water elevations. (h) Work completed. Report in progress.

(1194) (a) BIRCH HILL OUTLET WORKS. (b), (c), (d) and (e) as in (1188). (f) To determine the discharge characteristics of the outlet works. (g) A 1:30 model was constructed of the approach channel, the outlet gates and the downstream channel as far as the Miller's River. Water was measured with an 8" x 4" Venturi and with a 4" x 2" Venturi. Tailwater elevations were controlled with a swing gate at the downstream end of the model. (h) Work completed. Report in progress.

(1302) (a) CALIBRATION OF SHIP LOGS. (b) Pitometer Log Corporation. (c) Check of design. (d) L. C. Neale and E. A. Taylor. (e) Prof. C. M. Allen. (f) To determine the characteristics of a new log design. (g) Two logs were calibrated on 84 foot rotating boom. The operating characteristics were determined at various velocities and for different angles of yaw. (h) Work completed. (i) Report on file at Pitometer Log Corp.

U.S.FOREST SERVICE, California Forest and Range Experiment Station.

(1303) (a) EFFECT OF BEDLOAD AND CHANNEL SLOPE ON RATING OF SAN DIMAS METERING FLUME. (b) California Forest & Range Experiment Station, Forest Service, U. S. Department of Agriculture, and other agencies measuring loaded stream flow and flow in steep channels. (c) Laboratory project in cooperation with University of California. (d) K. J. Bermel, R. G. Folsom. (e) Director, California Forest and Range Experiment Station; or Prof. M. P. O'Brien, University of California. (f) Continue calibration of the standardized metering flume under various conditions of bedload and channel slopes. (g) Laboratory experiments on models. (h) Testing of six-inch and one-foot flumes in the laboratory using clear water has been completed. See abstract in this issue. (i) Temporarily inactive.

(1304) (a) MODEL STUDY OF FLOOD AND EROSION CONTROL STRUCTURES FOR MOUNTAIN CHANNELS (FOR LOS ANGELES RIVER FLOOD CONTROL PROJECT OF THE U.S.D.A.), (b) Forest Service, Region 5, U.S. Department of Agriculture. (c) Laboratory project in cooperation with University of California and in collaboration with California Forest and Range Experiment Station. (d) E. H. Taylor, K. J. Bermel, R. Stickel. (e) Regional Forester, Forest Service, San Francisco; Prof. M. P. O'Brien, Univ. of California; Director, California Forest & Range Exp. Station. (f) To supplement and verify hydraulic design computations of four barriers, scour and backwater conditions below the barriers, gradients of impounded material, and the effects of other appurtenant structures and replanting operations. (g) Four barriers planned for construction in the channel of the Arroyo Seco will be reproduced in model form on a scale of one to fifty. Sufficient length of channel upstream and downstream of the structures (from 2000 to 6000 ft) will be included to insure proper approach and backwater conditions. A basin 2.5' x 74' x 110' with a sloping bottom will accommodate two of the four channel layouts simultaneously. The channels are to be excavated in the sand-clay backfill within the basin, using male templates as guides for the shaping. (h) Model basin under construction, to be completed Dec. 15, 1941. Data sheets to place and construct templates in progress. Patterns to construct first barrier completed. (i) Investigations on first model are estimated to start Feb. 1, 1942.

(1305) (a) WATERSHED MANAGEMENT (Southern California) (b) California Forest & Range Experiment Station, Forest Service, U. S. Department of Agriculture, and other agencies responsible for the management of watersheds and production of water supplies. (c) Comprehensive investigation of hydrology, erosion, and related studies in mountainous watersheds of California, including laboratory studies at selected field stations and at Berkeley headquarters. (d) J. D. Sinclair, H. C. Storey, E. L. Hamilton, J. S. Horton, E. A. Colman, L. F. Reiman, L. A. Andrews. (e) Director, California Forest and Range Experiment Station; and C. J. Kraebel, in charge Division of Forest Influences. (f) Investigation of the influence of rainfall, physiography, vegetative cover, and watershed denudation or other treatment upon total water yield and rates of run-off and erosion. (g) Hydrologic measurements in watersheds of various sizes from 0.06 to 14.1 square miles, under normally vegetated conditions and denuded by fire, study of surface run-off and erosion from plots; lysimeter experiments to determine transpiration requirements and effect on percolation rates of various types of vegetation; and studies of meteorological factors, vegetation, soils, geology, and zoology of the watershed areas. Major work center is San Dimas Experimental Forest, a 17,000-acre tract embracing the mountainous watersheds of San Dimas and Big Dalton Creeks in Angeles National Forest, 30 miles east of Los Angeles. These two drainages have been divided into 10 watersheds ranging from 750 to 8600 acres, and 7 smaller units with areas of from 35 to 100 acres. Research equipment includes: 314 standard and 23 intensity rain gages, 142 lysimeters, 6 climatic stations, 17 concrete stream-gaging stations with flumes, weirs, and recording apparatus, 9 Forest Service dams and 2 large Los Angeles County Flood Control dams for storage and measurement of eroded material from watersheds, 18 small plots for studying surface run-off and erosion, and all necessary administrative improvements such as roads, trails, headquarters buildings, laboratory, and telephone system. (h) Collection of records was begun upon completion of each research installation principally during the period 1933 to 1937 and office reports prepared summarizing seasonal measurements. Publications during the period 1938 to 1941 are given under heading, Abstracts of Completed Projects and References to Publications, of this Bulletin. Other papers on plot results, streamflow data, vegetation and animal surveys and other subjects are in preparation. (i) Investigations expected to continue 25 years or longer, aiming at the development of methods of watershed management to provide, for any given area, the maximum yield of useful water compatible with satisfactory control of erosion and runoff and correlated with other watershed uses such as grazing, logging, recreation, etc. Results will be published occasionally as warranted.

(1306) (a) WATERSHED MANAGEMENT (SIERRA NEVADA). (b), (c), (e), (f) (i) as in (1305). (d) J.D. Sinclair, H. C. Storey, K. J. Bermal, L. A. Andrews. (g) Hydrologic measurements in watersheds of various sizes from 0.01 to 0.86 square mile, under normally vegetated conditions, denuded by fire, treated by grazing, logging, or otherwise; and studies of meteorological factors, vegetation, soils, geology, and zoology of the watershed areas.

Major work center is Kings River Branch Station within the Kings River drainage of the southern Sierra Nevada. Studies are carried on at two type localities; namely Big Creek and Teakettle Creek. The Big Creek area ranges in elevation from 1000 to 2500 feet and comprises seven small watersheds, 20 to 36 acres in area, in the foothill woodland-grass type. The Teakettle Creek area ranges in elevation from 6000 to 8000 feet and comprises three 500-acre watersheds in the conifer forest type with precipitation largely in the form of snow. Records are being collected at 4 climatic stations, 100 rain gages, 15 snow courses, and 12 stream gaging and erosion measuring stations. Facilitating roads, trails, and field headquarters buildings have been constructed. (h) Collection of records was begun upon completion of each research installation, starting in 1936, and office reports prepared summarizing seasonal measurements. A mimeographed pamphlet describing the Kings River Branch Watershed Study Units, by S. M. Munson, was issued in August 1938 as California Forest & Range Experiment Station Technical Note No. 11.

(1307) (a) INFLUENCE OF FOREST VEGETATION ON STREAMFLOW AND SOIL EROSION. (b) California Forest & Range Experiment Station, Forest Service, U. S. Department of Agriculture. (c) Intensive laboratory and field studies of the influences of forest vegetation on the disposition of precipitation as they affect water yield, surface run-off, and erosion. (d) P. B. Rowe, T. W. Daniel, and assistants. (e) Director, California Forest and Range Experiment Station; and C. J. Kraebel, in charge Division of Forest Influences. (f) Investigations of the role of the coast chaparral and other vegetation, including mustard cover and various types of forest litter, in the management of watersheds for flood and erosion control and the production of usable water. (g) Experimental installations include: 1 series of 8 rectangular slope lysimeters established 1928 and 2 series of 5 rectangular slope lysimeters established 1931, equipped for employing both artificially applied and natural rainfall to determine effects of litter and vegetation cover, soil type, and surface slope on surface runoff, percolation, evaporation, and erosion; 2 series of 5 rectangular slope lysimeters established 1931, each lysimeter 80 sq ft in area and 50 inches deep, 1 series planted to <u>Quercus dumosa</u> 1933 and one series to <u>Ceanothus cuneatus</u> 1933; 3 pairs 1/60-acre surface run-off and erosion plots established 1932 - vegetation on one pair burned annually, on one pair periodically, and on one pair undisturbed; 3 standard weather stations and various meteorological equipment. (h) Data collected to date completely tabulated and analyses in progress. Parts of data published prior to 1940; no publications since 1940. (i) One series of 8 lysimeters and 2 series of 5 lysimeters temporarily discontinued in 1938 and 1941, respectively. Publication of parts of data planned for 1942 and 1943.

(1308) (a) INFLUENCE OF FOREST VEGETATION ON STREAMFLOW AND SOIL EROSION. (b) California Forest & Range Experiment Station, Forest Service, U. S. Department of Agriculture. (c) Intensive field studies of influences of forest vegetation on the disposition of precipitation as they affect water yield, surface run-off, and erosion. (d) P. B. Rowe, T. M. Hendrix, and assistants. (e) Director, California Forest and Range Experiment Station; and C. J. Kraebel, in charge Division of Forest Influences. (f) Investigations of the role of forest, woodland and chaparral cover in the management of watersheds for flood and erosion control and the production of usable water. (g) Experimental installations include: 1. At North Fork, California - Sierra Nevada foothill woodland chaparral type: 3 pairs of 1/40-acre surface run-off and erosion plots established 1929; 2 pairs of 1/100-acre surface run-off and erosion plots established 1933 and equipped for obtaining data from natural and artificially applied rainfall; three 1/20-acre soil-moisture sampling plots; 8 lysimeters; 2 stemflow-interception units; 3 soil temperature pits; 6 snow stations; 1 weather station and various meteorological equipment; automatic precipitation and run-off recording devices. 2. At Bass Lake, California - Sierra Nevada second-growth ponderosa pine type: 2 triplicate sets of 1/40-acre surface run-off and erosion plots established in 1934; three 1/20-acre soil moisture sampling areas; 1 stemflow -interception unit; 5 snow courses; 1 standard weather station and various meteorological equipment; automatic precipitation and run-off recording devices. (h) Data collected to date completely tabulated and analyses in progress. Results indicate effectiveness of natural undisturbed vegetation in controlling floods and erosion and maintaining maximum yield of usable water. Publications since 1940 are given under heading, Abstracts of Completed Projects and References to Publications, of this bulletin. (i) North Fork studies to be completed about 1945. Bass Lake studies, including effects of logging, to be continued for about 10 years.

(1309) (a) INFLUENCE OF FOREST VEGETATION AND LAND USE ON STREAMFLOW AND SOIL EROSION. (b) California Forest and Range Experiment Station, Forest Service, U. S. Department of Agriculture. (c) Intensive field studies of the influences of various physiographic, climatic, and biotic factors as they affect the infiltration capacity of soils. (d) P. B. Rowe and assistants. (e) Director, California Forest and Range Experiment Station; and C. J. Kraebel, in charge Division of Forest Influences. (f) 1. To test and perfect infiltrometer equipment for field sampling. 2. To determine the influence of such factors as soil type, vegetation cover, land use, and intensity and duration of rainfall on the infiltration capacity of soils. 3. To develop methods of applying infiltration data in watershed hydrologic analyses. (g) The North Fork portable small plot infiltrometer, employing both the North Fork and F. A. types of rainfall applicators and similar equipment, tested and used in field infiltration studies. (h) Studies to determine some of the relations between the environmental factors, including land use, and the infiltration capacities of soils as they affect run-off, water yield, and erosion have been completed at: (1) The North Fork and San Joaquin experimental watercycle-soil installations; (2) Friant, California, in cooperation with the Bureau of Reclamation, Central Valley, Project, on a 100-acre experimental watershed; and (3) on the Pajaro and Santa Maria River drainages. The field work for the Pajaro and Santa Maria infiltration studies was done by U. S. Dept. of Agriculture, Flood Control Surveys. Analyses of data in progress. Publications are listed under heading, Abstracts of Completed Projects and References to Publications, in this bulletin. (i) Publications on the application of infiltration data in hydrologic analyses in progress.

U. S. GEOLOGICAL SURVEY.

(1310) (a) GROUND-WATER INVESTIGATIONS IN VARIOUS SECTIONS OF THE UNITED STATES. (b) Regional offices of the Division of Ground Water, U. S. Geological Survey. (c) Determination of mechanical analysis, specific retention, specific yield, and permeability of samples of water-bearing materials. (d) Alan C. Byers and R. G. Kazmann. (e) O. E. Meinzer, Chief, Division of Ground Water.

THE PANAMA CANAL HYDRAULICS LABORATORY

(1013) (a) MANIFOLD RESEARCH. (b) The Panama Canal Third Locks Project. (c) Design project. (d) Hydraulic Section personnel under the supervision of F. W. Edwards, Senior Hydraulic Engineer. (e) The Governor, The Panama Canal. (f) and (g) See Bulletin VIII, 1940. (h) Project completed. Reports available. (i) Method of designing manifolds from data for a single port has been developed and verified.

(1200) (a) CONTROL OF SURGES IN CANAL. (b), (c), (d), and (e) See (1013). (f) and (g) See Bulletin IX, 1941. (h) Project completed. (i) Surge reservoir plan recommended.

(1201) (a) LOWER APPROACHES TO LOCKS. (b), (c), (d), and (e) See (1013). (f) and (g), See Bulletin IX, 1941. (h) Project completed. (i) Solid approach walls of equal length and symmetrically flared at 4 degrees with the center line of channel were adopted.

(1202) (a) MODEL OF EXISTING LOCK. (b), (c), (d), and (e) See (1013). (f) and (g), See Bulletin IX, 1941. (h) Model in operation.

(1203) (a) MODEL OF PROPOSED LOCK. (b), (c), (d), and (e) See (1013). (f) and (g) See Bulletin IX, 1941. (h) Preliminary testing completed. Final revision of model in progress.

(1204) (a) MODEL OF LOCK INTAKE AND VALVES (b), (c), (d), and (e) See (1013). (f) and (g) See Bulletin IX, 1941. (h) Study of sector and tainter valves completed. Preliminary testing of intakes completed. Final revision of intakes in progress.

(1311) (a) FORCES FOR OPERATING MITER GATES. (b). (c). (d), and (e), See (1013). (f) The purpose of the investigation is to determine the forces required to operate the miter gates for the Third Locks. (g) A 1/25 scale model of a pair of miter gates has been constructed in an open flume. Reproduction of the miter gate operating cycle is obtained by means of a mechanical arrangement propelled by an electric motor. The force operating the gates is applied through a torque shaft in line with the pintle. The twist of the shaft which is measured by means of a strain gage has been calibrated for known forces. The flume length and other boundary conditions, speed of operation of the gates, and kinematics of the operating cycle may be varied. (h) Preliminary tests completed. Further testing in progress.

U. S. SOIL CONSERVATION SERVICE, Hydrologic Division.

(1264) (a) RUNOFF STUDIES ON SMALL DRAINAGE BASINS. (b) Soil Conservation Service, U. S. Department of Agriculture. (c) Hydrologic field investigations. (d) D. B. Krimgold and others. (e) C.E. Ramser, Chief, Hydrologic Division, Soil Conservation Service, (attention D. B. Krimgold). (f) To secure data on rates and amounts of runoff for use in the design of conservation structures and practices in a number of runoff problem areas of the United States. (g) Runoff studies were continued on some 120 small drainage basins ranging in size from about 10 acres to 2,000 acres and typical with respect to physiography, soils, cover, and tillage of runoff problem areas in various parts of the United States. Most of these watersheds were established early in 1938. Rates and amounts of precipitation are measured by means of recording raingages. Rates and amounts of runoff are obtained by means of triangular weirs with trapezoidal crests and type H flumes equipped with water level recorders. Continuous records of temperature and humidity are secured by means of hygrothermographs. Topographic, soil, and cover and tillage maps are prepared for each of the drainage basins. (h) The construction of the necessary installations on all drainage basins was completed. Records of precipitation and runoff and of related information for periods ranging from two to four years were obtained from all watersheds. Descriptive bulletins including two or more years of data are being prepared for publication. Methods for analyses are being developed. (i) The runoff studies are conducted on the demonstration projects of the Soil Conservation Service. The geographic distribution of the drainage basins under investigation is as follows:

Cohocton, N. Y.	4	Bentonville, Ark.	6	Santa Paula, Cal.	5
Freehold, N. J.	4	Edwardsville, Ill.	4	Watsonville, Cal.	4
Hagerstown, Md.	5	Fennimore, Wis.	4	Newberg, Oregon	4
College Park, Md.	9	Vega, Texas	3	Emmett, Idaho	2
Chatham, Va.	3	Lower Arkansas	6	Moscow, Idaho	2
Blacksburg, Va.	2	Colorado Springs, Colo.	4	Dayton, Wash.	1
Americus, Georgia	4	Muskogee, Oklahoma	4	Pullman, Washington	4
Athens, Ga.	1	Safford, Arizona	4	Guthrie, Oklahoma	10
Hamilton, Ohio	4	Albuquerque, N.M.	3	Colorado-Concho	6
Garland, Texas	6	Santa Fe, N.M.	3		

(1312) (a) NORTH APPALACHIAN EXPERIMENTAL WATERSHED, Coshocton, Ohio. (b) Soil Conservation Service, U. S. Department of Agriculture. (c) Study of the effects of agricultural land use on run-off and soil erosion. (d) W. D. Ellison, project supervisor, Coshocton, Ohio. (e) C.E. Ramser, Chief, Hydrologic Division, Soil Conservation Service, Washington, D. C. (Attention: Waldo E. Smith) (f) To determine the effect of land-use practices on run-off and the conservation of soil and moisture, and to secure data on rates and amounts of run-off for design of conservation and flood control structures. (g) Data on stream flow, rainfall, soil type and condition, vegetal cover, tillage practices, and other hydrologic factors are being gathered and analyzed on 46 single and mixed cover watersheds ranging in size from 0.65 to 31,300 acres, and on 11 in situ lysimeters (three set on scales) of 0.002 acre size. (h) The first watershed was placed in operation in September 1936 and the last in August 1939. Data for the year 1939 were published in Hydrologic Bulletin No. 1 of the U. S. Department of Agriculture, and those for 1940 in Hydrologic Bulletin No. 4 are in the process of publication. Methods of analyses are being developed. (i) Similar studies are being conducted on experimental watersheds near Waco, Texas and Hastings, Nebraska.

(1313) (a) BLACKLANDS EXPERIMENTAL WATERSHED, Waco, Texas. (b) Soil Conservation Service, U. S. Department of Agriculture. (c) Study of the effects of agricultural land use on run-off and soil erosion. (d) Ralph W. Baird, project supervisor, Waco, Texas. (e) C. E. Ramser, Chief, Hydrologic Division, Soil Conservation Service, Washington, D. C. (Attention: Waldo E. Smith). (f) To determine the effect of land-use practices on run-off and the conservation of soil and moisture, and to secure data on rates and amounts of run-off for design of conservation and flood control structures. (g) Data on stream flow, rainfall, vegetal cover, soil type and condition, tillage practices, and other hydrologic factors are being gathered and analyzed on 31 single and mixed cover watersheds ranging in size from 3 to 5,860 acres and on 4 single cover plots of 0.243 acre. (h) The first watershed was placed in operation in April 1937 and the last in March 1939. Data for the years 1937-39 are to be published in Hydrologic Bulletin No. 2 of the U. S. Department of Agriculture and those for 1940 in Hydrologic Bulletin No. 6. A comprehensive description of the area, including detail maps, is to be published in Hydrologic Bulletin No. 5. (i) Similar studies are being conducted on experimental watersheds near Coshocton, Ohio and Hastings, Nebraska.

(1314) (a) CENTRAL GREAT PLAINS EXPERIMENTAL WATERSHED, Hastings, Nebraska. (b) Soil Conservation Service, U. S. Department of Agriculture. (c) Study of the effects of agricultural land use on run-off and soil erosion. (d) John A. Allis, project supervisor, Hastings, Nebraska. (e) C.E.Ramser, Chief, Hydrologic Division, Soil Conservation Service, Washington, D.C. (Attention: Waldo E. Smith). (f) To determine the effect of land-use practices on run-off and the conservation of soil and moisture, and to secure data on rates and amounts of run-off for design of conservation and flood control structures. (g) Data on stream flow, rainfall, vegetal cover, soil type and condition, tillage practices, and other hydrologic factors are being gathered and analyzed on 28 single and mixed cover watersheds ranging in size from 3.4 to 3,490 acres and from 8 pasture plots of 0.69 acre. (h) The first watershed was placed in operation in July 1938. By August 1939, 22 watersheds and 8 plots were operating. The six watersheds for crop residue studies were started in March 1941. Data for the years 1938-40 are to be published in Hydrologic Bulletin No. 3 of the U. S. Department of Agriculture. (i) Similar studies are being conducted on experimental watersheds near Coshocton, Ohio and Waco, Texas.

(1315) (a) NAVAJO EXPERIMENT STATION, Mexican Springs, New Mexico. (b) Soil Conservation Service, U. S. Department of Agriculture. (c) Run-off and erosion investigations on agricultural watersheds. (d) D. S. Hubbell, project supervisor, Mexican Springs, New Mexico. (e) C. E. Ramser, chief, Hydrologic Division, Soil Conservation Service, Washington, D. C. (Attention: Waldo E. Smith). (f) To determine the rates and amounts of run-off and the silt load in run-off water from the watersheds in the semiarid Southwest. (g) Rates and amounts of run-off are being measured on eight watersheds ranging in size from 200 to 21,000 acres. Silt samples are taken in the run-off waters periodically throughout the run-off periods. 79 recording rain gages are well distributed over the area. (h) Records for 1940 and 1941 will be published when a sufficient number of current meter measurements have been obtained to establish the stage-discharge relations. Isohyetal maps by 15-minute periods have been prepared for several storms.

(1316) (a) HYDROLOGIC STUDIES ON WATERSHEDS AT THE SOIL AND WATER CONSERVATION EXPERIMENT STATIONS. (b) Soil Conservation Service, U. S. Department of Agriculture. (c) Study of the effects of agricultural land use on run-off and soil erosion. (d) Project supervisors and station staffs at Zanesville, Ohio; La Crosse, Wisc.; Clarinda, Iowa; Bethany, Mo.; Cherokee, Okla.; and Tyler, Texas. (e) C. E. Ramser, Chief, Hydrologic Division, Soil Conservation Service, Washington, D. C. (Attention: Waldo E. Smith). (f) To determine the effect of land-use practices on run-off and the conservation of soil and moisture, and to secure data on rates and amounts of run-off for design of conservation and flood control structures. (g) Rainfall, run-off, and land-use data are recorded on cultivated, pasture, meadow, and wooded watersheds at these stations. Some of the stations have no wooded and others have no pasture or meadow watersheds. Improved practices, such as contour tillage, terracing, strip-cropping, basin listing, stubble mulching, are applied to some of the cultivated watersheds and others are kept under prevailing practices. (h) Hydrologic data for the watersheds at Zanesville, Ohio for the years 1933-38 were published in SCS-TP-26; those at La Crosse, Wisc., for the years 1932-38 in SCS-TP-29; those at Clarinda, Iowa, for the years 1934-38 in SCS-TP-31; those at Guthrie, Okla., for the years 1931-38 in SCS-TP-32; those at Bethany, Mo., for the years 1933-40 in SCS-TP-39; and those at Tyler, Texas, for the years 1931-39 in SCS-TP-41. The watersheds at Cherokee, Okla., were placed in operation in July 1941.

(1317) (a) HYDROLOGIC STUDIES ON WATERSHEDS AT STATE AGRICULTURAL EXPERIMENT STATIONS. (b) Soil Conservation Service, U. S. Department of Agriculture. (c) Study of the effects of agricultural land use on run-off and soil erosion. (d) Project supervisors and station staffs at Ithaca, N.Y.; La Fayette, Ind.; and East Lansing, Mich. (e) C. E. Ramser, Chief, Hydrologic Division, Soil Conservation Service, Washington, D. C. (Attention: Waldo E. Smith). (f) To determine the effect of land-use practices on run-off and the conservation of soil and moisture, and to secure data on rates and amounts of run-off for design of conservation and flood control structures. The studies at the East Lansing, Michigan, station are primarily directed towards the effect of frost and snow on the hydrologic performance of the watersheds. (g) At Ithaca, N. Y., 6 watersheds, ranging in size from 9 to 18 acres, were established in 1940-41 on poorly drained soil, 3 of which are wooded and 3 are on cut-over land. At La Fayette, Indiana, 20 watersheds, ranging in size from 1.7 to 3.5 acres, were established in 1940 on agricultural land. Two of these watersheds are wooded, four pasture, and the remaining 14 are planted and cultivated alike. In the near future improved land-use practices will be applied to half of the cultivated watersheds. Two cultivated and one wooded watersheds of about 2 acres each (established in 1941) at East Lansing, Michigan, are being studied to determine the manner in which freezing and thawing of soils under varying types of land use affect run-off, erosion, flood flow, and the movement of water through the soil profile. (h) The data at all stations are being collected and tabulated for analysis and publications.

U. S. SOIL CONSERVATION SERVICE, Hydrologic Division, Alabama Agricultural Experiment Station, Auburn, Alabama.

(341) (a) STUDY OF MEASURING FLUMES. (b) Hydrologic Division, Soil Conservation Service, U. S. Department of Agriculture. (c) Instrumentation research. (d) D. A. Parsons. (e) C. E. Ramser, Chief, Hydrologic Division, Soil Conservation Service, (Attention: D. A. Parsons). (f) The development and calibration of more suitable devices for the measurement of rates of runoff from experimental areas. (g) The immediate study will be confined to the determination of the most suitable types of approach conditions for the Type H and HS flumes from the standpoint of the maintenance of a stable head-discharge relationship with a small storage correction and relative freedom from silt deposition within the installation. (h) After the construction and trial of many types of flumes, the H and HS designs have been selected for use for flows up to thirty cubic feet per second. Plans and calibration tables have been prepared. (i) The work on this study was transferred from the Hydraulic Laboratory, National Bureau of Standards, to Auburn, Alabama, in July 1940. Although there is great need for this work, little time has been given to this study to date.

(936) (a) STUDY OF THE EFFECT OF RAINFALL IMPACT ON INFILTRATION AND WATER EROSION. (b) Hydrologic Division, Soil Conservation Service, U. S. Department of Agriculture. (c) Research in mechanics of erosion. (d) J. O. Laws, N. L. Stoltenberg. (e) C. E. Ramser, Chief, Hydrologic Division, Soil Conservation Service (Attention: D. A. Parsons). (f) To investigate the roles of the size and velocity of raindrops in the water-erosion process. (g) Studies are being made of the velocity and energy of water-drops of various sizes, of the effect of rain energy on the erosion from elementary areas of soil and of the characteristics of natural raindrops. (h) Publications to date are "Recent Studies in Raindrops and Erosion," Agricultural Engineering, January 1940, and "Measurements of the Fall-Velocities of Water-drops and Raindrops," Transactions American Geophysical Union, 1941, Fall velocities and drop sizes in natural rain have been measured, high-speed motion pictures were obtained of water-drops striking soil surfaces, and tests were made which have shown that rain characteristics have a large effect upon infiltration and erosion. Recent test results give promise of a more exact knowledge of the relation between infiltration, drop size and drop velocity.

(1267) (a) STUDY OF THE FLOW OF WATER AT SMALL DEPTHS OVER SOIL SURFACES AND THE RESULTANT SCOUR. (b) Hydrologic Division, Soil Conservation Service, U. S. Department of Agriculture. (c) Research in the mechanics of erosion. (d) D. A. Parsons, J. O. Laws, N. L. Stoltenberg. (e) C. E. Ramser, Chief, Hydrologic Division, Soil Conservation Service, (Attention: D. A. Parsons). (f) (1) To determine the hydraulic principles involved in the flow of water in thin sheets and (2) the pertinent factors and their inter-relationship that are involved in the scour and transportation of soil by water, flowing in thin sheets. (g) The tests are to be made in a tilting flume approximately two feet in width and will be confined to depths of water less than one-tenth foot. Slope, bed material, and depth of water will be controlled variables for the first experiments, but, if the study appears to warrant expansion, the tests may be repeated in part with the application of a spray of known qualities, or with different surface and roughness conditions.

U. S. SOIL CONSERVATION SERVICE, Hydrologic Division, St. Anthony Falls Hydraulic Laboratory, Minneapolis, Minnesota.

(1265) (a) STUDY OF RATE-OF-RUNOFF MEASURING DEVICES. (b) Hydrologic Division, Soil Conservation Service, U. S. Department of Agriculture. (c) Instrumentation research. (d) A.N.Huff, F.W.Blaisdell. (e) C.E.Ramser, Chief, Hydrologic Division, Soil Conservation Service, (attention: D.A.Parsons). (f) The development and calibration of more suitable devices for the measurement of rates of runoff from experimental areas. (g) Work has been virtually completed on the V-shaped type of control now in considerable use by the Soil Conservation Service. (i) This is a continuation of previous work done at the Hydraulic Laboratory, National Bureau of Standards and the Hydraulic Laboratory at Cornell University.

(1266) (a) DESIGN OF EROSION-CONTROL STRUCTURES. (b) Hydrologic Division, Soil Conservation Service, U. S. Department of Agriculture. (c) Studies in conservation hydraulics. (d) A.A.Huff, F. W. Blaisdell. (e) C. E. Ramser, Chief, Hydrologic Division, Soil Conservation Service, (Attention: D. A. Parsons). (f) To determine the most economical, hydraulically correct, erosion-control structures. (g) Model tests of particular structures, proposed or in place, are being made. They include drop inlet culverts, drop boxes, steep chutes and various outlet structures.

U. S. SOIL CONSERVATION SERVICE, Hydrologic Division, Stillwater, Oklahoma.

(931) (a) STUDY OF THE EFFECT OF LINING CHARACTERISTICS ON THE HYDRAULIC BEHAVIOR OF CONSERVATION CHANNELS. (b) Soil Conservation Service, U. S. Department of Agriculture. (c) Studies in conservation hydraulics. (d) W. O. Ree, W. P. Law, S. H. Anderson. (e) C. E. Ramser, Chief, Hydrologic Division, Soil Conservation Service (attention D. A. Parsons). (f) To obtain data on channel capacities for use in the design of the hydraulic works constructed in soil and water conservation operations. (g) Measured flows are passed through outdoor test channels of various cross-sections and slopes, and measurements of the hydraulic elements are made to determine the effect of different linings on channel capacity. Special emphasis is placed on the study of vegetal linings. (h) Vegetations tested to date included Bermuda, Centipede, Dallis, and Sudan grasses, as well as Lespedeza Sericea, Common Lespedeza, and Kudzu. Tests of soil-cement and cotton-reinforced bituminous linings are also under way. (i) For further description see Civil Engineering, October 1938. Several in-Service data releases have been prepared. This work was formerly conducted at Spartanburg, S.C.

(932) (a) STUDY OF THE CAPACITIES OF NOTCHES AND OTHER APERTURES IN CONSERVATION STRUCTURES. (b) Soil Conservation Service, U. S. Department of Agriculture. (c) Studies in conservation hydraulics. (d) W. O. Ree, W. P. Law. (e) C. E. Ramser, Chief, Hydrologic Division, Soil Conservation Service, (attention D. A. Parsons). (f) To obtain data on notch capacities for application in the design of the hydraulic works constructed in soil and water conservation operations. (g) Full-size rectangular apertures of various dimensions are tested by passing measured flows of water through them. Additional data are obtained by testing models of the notches. (h) The test program has been completed. The results have not yet been published. The experimental work was formerly conducted at Spartanburg, S. C.

(933) (a) STUDY OF ALLOWABLE VELOCITIES FOR VEGETAL CHANNEL LININGS. (b) Soil Conservation Service, U. S. Department of Agriculture. (c) Studies in conservation hydraulics. (d) W.O. Ree, W. P. Law, S. H. Anderson. (e) C. E. Ramser, Chief, Hydrologic Division, Soil Conservation Service, (attention D. A. Parsons). (f) To obtain data on the protective characteristics of various types of vegetation for direct application in the design of the hydraulic works constructed in soil and water conservation operations. (g) The outdoor test channels used in the study of hydraulic characteristics of linings are also utilized for the determination of allowable velocities. For each vegetation the rates of scour are determined for flows of various magnitudes and compared with the scour rates for other vegetations and for unlined channels. (h) Allowable velocities have been determined for all of the vegetal linings itemized in the description of the study of the hydraulic characteristics of channel linings. (i) For further description see Civil Engineering, October 1938. A part of the data have been reported within the Service along with the channel capacity data obtained in the study of the effect of lining characteristics. This work was formerly conducted at Spartanburg, S. C.

TENNESSEE VALLEY AUTHORITY.

A. CURRENT HYDRAULIC LABORATORY RESEARCH PROJECTS. Items (b), (d), and (e) are the same for all projects and their significance is as follows: (b) Tennessee Valley Authority (d) Laboratory staff under direction of G. H. Hickox. (e) A. S. Fry, Head Hydraulic Research Engineer, Tennessee Valley Authority, Knoxville, Tennessee.

(494) (a) PICKWICK LANDING DAM, SPILLWAY DESIGN. (b) to (i) See Bulletin IX for details.

(574) (a) HIWASSEE DAM, SPILLWAY DESIGN. (b) to (i) See Bulletin IX for details.

(708) (a) GUNTERSVILLE DAM, SPILLWAY DESIGN. (b) to (i) See Bulletin IX for details.

(709) (a) CHICKAMAUGA DAM, SPILLWAY DESIGN. (b) to (i) See Bulletin IX for details.

(939) (a) HIWASSEE DAM, CAVITATION AT SLUICE ENTRANCES. (b) to (h) See Bulletin IX for details. (i) Report completed.

(1129) (a) KENTUCKY DAM. SPILLWAY DESIGN. (b) to (i) See Bulletin IX for details.

(1133) (a) NORRIS DAM, SLUICE CALIBRATION. (b) to (h) See Bulletin IX for details.

(1214) (a) CHICKAMAUGA DAM, WAVE ACTION BELOW LOCK WALL EXTENSION. (b) to (h) See Bulletin IX for details.

(1215) (a) FORT LOUDOUN DAM, NAVIGATION MODEL. (b) to (g) See Bulletin IX for details. (h) Tests completed. (i) Report completed.

(1216) (a) FORT LOUDOUN DAM, SPILLWAY MODEL. (b) to (h) See Bulletin IX for details.

(1217) (a) HIWASSEE DAM, PROTOTYPE CHECK. (b) to (h) See Bulletin IX for details.

(1218) (a) CHEROKEE DAM, SPILLWAY MODEL. (b) to (i) See Bulletin IX for details.

(1219) (a) CHEROKEE DAM, SLUICE MODEL. (b) to (h) See Bulletin IX for details. (i) Report completed.

(1318) (a) KENTUCKY DAM, PENSTOCK INTAKE GATE. (c) Investigation of downpull on gate. (f) To determine the hydraulic load on the penstock intake gate during opening and emergency closure. (g) Tests were made on 1:15 scale model. The total load was measured by weighing, and the hydraulic load was determined by subtracting the dead weight of the gate. (h) Tests completed. (i) Report completed.

(1319) (a) PICKWICK LANDING DAM, PROTOTYPE CHECK. (c) Observations on prototype structure. (f) To compare operation of prototype with results predicted by models. (g) Lateral pressures on piers will be measured for various conditions of gate operations; air requirement of spillway when discharging over lower gate will be determined; performance of floating boom at various discharges will be observed. The results will be compared with the model tests. (h) Air requirementsof spillway have been determined; performance of floating boom has been observed at discharges up to 100,000 cubic feet per second. (i) Report on air requirement completed.

(1320) (a) NAVIGATION NEAR MOUTH OF LITTLE TENNESSEE RIVER. (c) Laboratory study of navigation conditions. (f) To determine the effect of discharge from the Little Tennessee River on navigation in the Tennessee River below Fort Loudoun Dam. (g) Tests were made on a 1:130 scale model of the Tennessee and Little Tennessee Rivers at their confluence, varying the discharge of both streams, and studying the effect on navigation conditions. The effect of training dikes in the Tennessee opposite the mouth of the Little Tennessee was also investigated. (h) Tests completed. (i) Report completed.

(1321) (a) OCOEE NO. 3 DAM, SPILLWAY DESIGN. (c) Study of apron and silt sluice for Ocoee No.3 Dam. (f) To develop an apron that would protect the dam from damage due to undermining; and to study the effect of a sluice in removing silt from the tunnel intake. (g) Tests were made on a 1:30 scale model of 3 bays in a flume with glass panels that permitted observation. This model was used to develop the apron design. The entire dam, including the silt sluice, was modeled at a scale of 1:100 to study erosion at the ends of the apron and below the silt sluice, and to investigate the effectiveness of the sluice in removing silt from the tunnel intakes. (h) Tests completed. (i) Report completed.

(1322) (a) OCOEE NO. 3 DAM, SURGE TANK MODEL. (c) Study of discharge coefficients at foot of differential surge tank riser. (f) To determine coefficients of discharge for both upward and downward flow through the annular port at the foot of the riser of a differential surge tank. (g) The tests were made on a 1:12.5 scale model of the port. Revisions in the shape were made until the discharge coefficient for flow downward exceeded that for flow upward by as much as 48 percent. (h) Tests completed. (i) Report completed.

(1323) (a) APALACHIA DAM, SPILLWAY DESIGN. (c) Study of apron for Apalachia Dam. (f) To develop an apron that would protect the dam from damage due to undermining. (g) Tests were made on a 1:30 scale model of 3 bays in a flume with glass panels that permitted observation. The apron design was developed by means of these tests. (h) Tests completed. (i) Report completed.

(1324) (a) CHATUGE DAM, SPILLWAY DESIGN. (c) Study of spillway design for Chatuge Dam. (f) To determine spillway coefficients; to investigate the form of chute below the spillway; and to develop a stilling basin that would dissipate the energy at the foot of the chute. (g) Discharge coefficients were measured on a 1:10 scale model of 3 spillway bays. The form of the chute and the stilling basin were studied on a 1:45 scale model of the entire spillway. It was found necessary to distort the slope of the chute to produce correct velocities at the entrance of the stilling basin. (h) Tests in progress.

(1325) (a) CHATUGE DAM, SLUICE OUTLET MODEL. (c) Study of erosion at sluice outlet. (f) To design a suitable stilling basin to prevent erosion that would undermine and endanger the structure. (g) Tests were made on 1:24 scale model of both an 84-inch differential needle valve and a 78-inch Howell-Bunger valve. Various designs of paved structure were tested. (h) Tests completed. (i) Report completed.

(1326) (a) NOTTELY DAM, SPILLWAY DESIGN. (c) Study of spillway design for Nottely Dam. (f) To determine spillway coefficients; to investigate the form of chute below the spillway; and to develop a stilling basin that would dissipate the energy at the foot of the chute. (g) Discharge coefficients were measured on a 1:10 scale model of 3 spillway bays. The form of the chute and the stilling basin were studied on a 1:45 scale model of the entire spillway. It was found necessary to distort the slope of the chute to produce correct velocities at the entrance of the stilling basin. (h) Tests in progress.

(1135) (a) WATTS BAR DAM, SPILLWAY DESIGN. (b) to (i) See Bulletin IX for details.

(Tennessee Valley Authority - continued)

B. CURRENT HYDROLOGICAL AND HYDRAULIC FIELD INVESTIGATIONS - Items (b) and (e) are the same for all projects and their significance is as follows: (b) Tennessee Valley Authority. (e) Albert S. Fry, Head Hydraulic Research Engineer, Tennessee Valley Authority. The following projects remain as published in Bulletin IX except as noted:

(950) (a) DETERMINATION OF SILT CARRIED IN SUSPENSION BY TENNESSEE RIVER AND TRIBUTARIES. (d) Meteorology Section, Hydraulic Data Division, by G. N. Burrell, under direction of Van Court Hare.

(951) (a) EVAPORATION IN THE TENNESSEE RIVER BASIN. (d) Hydro-Meteorological Section, Hydraulic Data Division. by Robert W. Gay, under direction of Van Court Hare.

(955) (a) GROUND-WATER INVESTIGATIONS. (d) Hydraulic Investigations and Hydro-Meteorological Sections, Hydraulic Data Division, under direction of B. E. Morriss and Van Court Hare, respectively. (g) Observation wells are dug and the record of the level of the water in these wells is compared with rainfall and river stages for periods before and after reservoir filling. Studies are being made for Cherokee, For Loudoun, Chickamauga, Guntersville, Pickwick Landing, Watts Bar, Wheeler, and Kentucky Reservoirs.

(956) (a) FLOOD INVESTIGATIONS - TENNESSEE RIVER AND TRIBUTARIES. (d) Hydraulic Investigations Section, Hydraulic Data Division, under direction of B. E. Morriss.

(958) (a) INVESTIGATION OF SPRINGS AND RUNS BELOW DAMS. (d) Hydraulic Investigations Section, Hydraulic Data Division, under direction of B. E. Morriss.

(959) (a) PRECIPITATION IN TENNESSEE RIVER BASIN. (d) Hydro-Meteorological Section, Hydraulic Data Division, under direction of Van Court Hare. (g) Records from 569 TVA,U. S. Weather Bureau, and private rain gages in Tennessee Valley are collected, compiled, and analyzed. Special investigations are made of unusual storms.

(960) (a) RESERVOIR TEMPERATURES. (d) Hydraulic Investigations Section, Hydraulic Data Division, under direction of B. E. Morriss. (g) Established ranges on Norris, Hiwassee, Chickamauga, Wheeler, Wilson, Pickwick Landing, and Guntersville Reservoirs are sounded monthly with a resistance thermometer, and readings are taken at every 5 or 10 feet of depth. Similar readings are taken in Tennessee River at Savannah and Johnsonville.

(961) (a) RUNOFF-SILT INVESTIGATIONS ON SMALL WATERSHEDS. (d) Hydraulic Investigations Section, Hydraulic Data Division, under direction of B. E. Morriss. (f) To determine the relation between rainfall, runoff, and silt over three small tributaries of Norris Reservoir and seven other experimental tracts in various parts of the Tennessee Basin that have been selected for forest influence studies.

(962) (a) SILTING OF EXISTING RESERVOIRS. (d) Hydraulic Investigations Section and Hydro-Meteorological section, Hydraulic Data Division, under direction of B. E. Morriss and Van Court Hare, respectively. (g) Selected ranges were proved and sounded for original and present bottom elevations, volumetric samples of deposited silt were collected and analyzed, and the quantity and distribution of silt were computed. Investigations have been made of Lake Davy Crockett on the Nolichucky River, Andrews Reservoir on the Hiwassee River, Parksville Reservoir on the Ocoee River, and Chickamauga, Hales Bar, Guntersville, and Wilson Reservoirs on the Tennessee River; and are being made at Cherokee Reservoir on the Holston River, Pickwick Landing, Watts Bar, and Fort Loudoun Reservoirs on the Tennessee River, Cheoah Reservoir on the Little Tennessee River, Chatuge and Apalachia Reservoirs on the Hiwassee River, Nottely Reservoir on the Nottely River, and Ocoee No.3 Reservoir on the Ocoee River.

(963) (a) SILT TRAVERSES - TENNESSEE RIVER TRIBUTARIES. (d) Meteorology Section, Hydraulic Data Division, by G. N. Burrell under direction of Van Court Hare.

(1220) (a) RADIO GAGES FOR REPORTING RAINFALL AND RIVER STAGES. (d) Hydraulic Investigations Section, Hydraulic Data Division, under direction of B. E. Morriss. (h) Sixteen rain-gages and ten radio stream gages are now being operated with a high degree of reliability. Additional installations featuring new improvements are under construction.

(1222) (a) INVESTIGATION OF WINDS AND WAVE HEIGHTS. (d) Hydraulic Investigations Section, Hydraulic Data Division, under direction of B. E. Morriss.

(1223) (a) BACKWATER EFFECT OF RESERVOIRS ON SMALL TRIBUTARIES. (d) Hydraulic Investigations Section, Hydraulic Data Division, under direction of B. E. Morriss. (h) A total of 188 crest markers have been established in Kentucky Reservoir and pre-reservoir profiles are being obtained. Similar studies on a smaller scale are being made in Chickamauga, Pickwick Landing, Watts Bar, Cherokee, and Fort Loudoun Reservoirs.

(1224) (a) MEASUREMENT OF VISIBILITY OF FOGS.

NATIONAL BUREAU OF STANDARDS (National Hydraulic Laboratory).

(42) (a) INVESTIGATION OF THE PHYSICS OF PLUMBING SYSTEMS. (b) National Bureau of Standards. (c) General research. (d) R. B. Hunter, E. Hermansen, R. E. Hoover. (e) The Director, National Bureau of Standards. (f) To obtain data on which to base logical estimates of the capacities of vertical and sloping drain pipes in plumbing systems, and to make a study of safety requirements with special reference to back-siphonage and venting. (g) It is proposed to collect and correlate as far as possible existing data on those subjects and to make such supplementary experiments as may be necessary to meet the purpose of the investigation. (h) Several reports have been published. See under heading, Abstracts of Completed Projects and References to Publications, in this bulletin. (i) This project is being carried on in conjunction with Project 797, also reported in this bulletin.

(43) (a) INVESTIGATION OF PIPE BENDS. (b) National Bureau of Standards. (c) General research. (d) K. H. Beij, G. H. Keulegan. (e) The Director, National Bureau of Standards. (f) To obtain the general laws of head loss in pipe bends; to obtain practicable formulas for use by engineers; and to extend the results to include flow of other fluids, such as oils, steam, etc. (g) Laboratory tests are planned on smooth and rough pipe bends of various diameters and central angles; and on miter bends and cast fittings. (h) Experiments on 1-inch smooth pipe coils of one to ten or twelve turns and radii up to about four feet are being made as opportunity offers. Three coils have already been tested.

(496) (a) DETERMINATION OF THE DISCHARGE COEFFICIENTS OF FLOW NOZZLES. (b) Cooperative research sponsored by the A.S.M.E. Special Research Committee on flow nozzles. (c) Cooperative research. (d) H. S. Bean, F. C. Morey. (e) The Director, National Bureau of Standards. (f) To determine discharge coefficients for "long-radius" flow nozzles; to determine the most satisfactory location for pressure holes; to check, compare, and correlate American and European designs and practices. (h) A final report containing a summary of all data collected on flow nozzle discharge coefficients under the sponsorship of the A.S.M.E. Special Research Committee on Fluid Meters is being assembled. (i) Work on this project has been curtailed recently by demands of National Defense.

(563) (a) AGING TESTS ON PIPES. (b) U. S. Treasury Department. (c) Cooperative project with the Division of Metallurgy, National Bureau of Standards. (d) K. H. Beij, E. Hermansen. (e) The Director, National Bureau of Standards. (f) To determine the effects of long-continued service on the hydraulic friction of pipes. (g) Specimens of 1-1/4 inch pipes of nine different materials have been installed in a cold-water line in constant service, and specimens of 3/4 inch pipes of seven different materials have likewise been installed in hot-water service lines at the National Bureau of Standards. It is planned to determine the hydraulic resistance coefficients of these specimens at intervals over a period of 20 years. (h) Preliminary tests (before aging) were made in 1936; observation tests were made in 1937, 1938, and 1940. The next tests are scheduled for August, 1942.

(564) (a) DENSITY CURRENTS. (b) National Bureau of Standards. (c) General research. (d) G.H. Keulegan, G. W. Patterson, H. N. Eaton, E. E. Ferguson. (e) The Director, National Bureau of Standards. (f) To determine the laws of currents in miscible stratified fluids. (h) A new series of experiments is being carried out with a larger testing channel for the purpose of ascertaining the extent of the scale effect on the process of mixing between the two liquids of different densities. These experiments have shown that (1) the commencement of mixing is affected very markedly by the nature of the disturbance at the entrance, (2) a larger length of channel is desirable and (3) the visual method of observing the beginning of mixing is not suitable for this channel. Attempts are being made to correct these objectionable features of the apparatus and the method of experimentation.

(616) (a) FLOW IN OPEN CHANNEL. (b) National Bureau of Standards. (c) General research. (d) G. H. Keulegan, G. W. Patterson. (e) The Director, National Bureau of Standards. (f) To investigate the phenomena of open-channel flow in the light of modern concepts of turbulent flow. This will involve a study of the dependence of the hydraulic friction factor on the cross-section of the channel and on the roughness of its surfaces, the apparent friction of the free surfaces, and the depression of the filament of maximum velocity. (i) Project temporarily inactive. Some of the results are being used in the papers prepared in connection with Project 977 reported in this Bulletin.

(797) PLUMBING MATERIALS AND EQUIPMENT AS RELATED TO LOW-COST HOUSING. (b) National Bureau of Standards. (c) Part of a coordinated program of research on low-cost housing. (d) R. B. Hunter, E. Hermansen, R. E. Hoover. (e) Dr. H. L. Dryden, Coordinator of Program, National Bureau of Standards. (f) To assemble the data necessary for developing uniform standards and specifications for materials and construction for plumbing installations in low-cost housing construction under Federal control. (g) A review and study of existing standards as they apply to the field of low-cost housing will be made, together with an experimental study of plumbing piping layouts (water-supply, drain, and vent pipes) relative to minimum requirements for the efficient functioning of the system. (h) Experimental work on this project has been completed, and the results are being published in the National Bureau of Standards Materials and Structures Series of reports. See under heading, Abstracts of Completed Projects and References to Publications, of this bulletin for a list of the reports already published.

(977) (a) MATHEMATICAL THEORY OF FLOOD WAVES. (b) U. S. Weather Bureau. (c) General research. (d) G. H. Keulegan and G. W. Patterson. (e) The Director, National Bureau of Standards. (f) To review and supplement the European and American literature on the mathematical theory of waves which is applicable to the theory of flood waves. (g) The results of this review will be extended and coordinated and will be published in a series of papers dealing individually with the following topics: (1) The mathematical theory of irrotational translation waves, (2) The secondary effects of turbulence in the theory of translation waves, (3) The viscous effects produced by the walls on the motion of waves, (4) The quasi-permanent régime of rivers, (5) American and European methods of flood routing, (6) Recent advances in the theory of turbulence. (h) The first paper of the series was published in the Journal of Research of the National Bureau of Standards, Vol.24, (1940), pages 47-101, as Research Paper RP1272. The manuscript of the second paper has been completed and is nearly ready for publication. The manuscripts of the third, fourth, and fifth papers are in process of preparation. An experimental and theoretical study of the damping of standing waves is being made.

(979) (a) DREDGE SUCTION BOOSTER. (b) The Division Engineer, U. S. Engineer Office, Richmond, Va. (c) Tests on the suction line of a pipe-line dredge with and without a booster pump at the suction-line entrance. (d) L. L. DeFabritis and K. H. Beij for the National Bureau of Standards; Lt.-Col. David L. Neuman for the U. S. Engineer Office, H. N. Eaton, E. Hermansen. (e) The Division Engineer, U. S. Engineer Office, Richmond, Va., or The Director, National Bureau of Standards. (f) To compare the concentration of solids and pressure gradients in the suction line of a small-size pipe-line dredge with and without a booster pump at the suction entrance for different velocities in the pipe and dredging from a sand bed that moves relatively to the line, with a view to determining the effect of the booster on the concentration of solids, sand output, and required vacuum at the intake of the dredge pump. (g) A sloping 3-inch suction line with an enlargement to a 4-inch diameter entrance remained fixed relatively to the submerged sand tank. The 3-inch main pump was set up in three positions attached to the sloping suction line. When worn, the 4-inch axial-flow propeller was replaced by a single-stage, mixed-flow pump assembly, 4-inch nominal diameter, complete with suction and discharge bowls and guide vanes. (h) See abstract under heading, Abstracts of Completed Projects and References to Publications, of this Bulletin.

(981) (a) INSTALLATION REQUIREMENTS FOR HEAD METERS. (b) Cooperative research sponsored by the A.S.M.E. Special Research Committee on Fluid Meters with the National Bureau of Standards. (c) Laboratory investigation simulating certain possible plant conditions. (d) A.S.M.E. Fluid Meters Committee, National Bureau of Standards. (e) H. S. Bean, National Bureau of Standards. (h) A paper giving a summary of the data collected and the conclusions on head-meter installation requirements was presented before the Appalachian Gas Measurement Short Course, August 1941. A summary of this paper appeared in the December 1941 issue of Heating, Piping, and Air Conditioning.

(1152) (a) TRANSPORTATION OF SAND IN PIPES. (b) Chief of Engineers, U. S. Army, Washington,D.C. (c) Research. (d) L. L. DeFabritis, K. H. Beij, and C. W. Elliot, for the National Bureau of Standards; H. K. Armstrong for the Office of the Chief of Engineers. (e) Chief of Engineers, U.S. Army, Washington, D. C. (f) To determine the laws of head loss in pipes carrying sand and water mixtures. (g) Tests are planned on black steel pipes having nominal diameters of 2,3,4, and 6 inches. Relatively complete study of the 4-inch size will include measurements of the head loss for a range of velocities transporting sand of a carefully controlled grain size in concentrations ranging from zero to the maximum possible, repeating the procedure with each of a sufficient series of grain sizes and arbitrary mixtures of grain sizes. Similar studies, but less intensive, will be made on the 2-inch and 3-inch pipe sizes over a corresponding range of conditions and on the 6-inch pipe size over a narrow range of velocities and concentrations. (h) Preliminary results have been obtained, but changes in the apparatus were necessary. These changes have been made, and tests are about to be resumed.

(1209) (a) TESTS OF SPILLWAYS, CIRCULAR IN PLAN. (b) U.S.Geological Survey. (c) Model studies of semi-circular spillways, a cooperative project with the U. S. Geological Survey. (d) E. Hermansen, K. H. Beij, C. W. Elliot, H. N. Eaton, R. E. Hoover (National Bureau of Standards), O.W.Hartwell (U. S. Geological Survey). (e) The Director, National Bureau of Standards. (f) To study the discharge characteristics of two semi-circular spillways, and, in particular, to obtain from models the head-discharge relationship for the prototypes. (g) Wooden models on a scale of 1:10 of two different semi-circular spillways were tested in a 25 ft by 35 ft tank. River bed contours were reproduced and head-discharge calibrations made. (h) The tests and reports have been completed. (i) The head-discharge relationships were dependent on the type of nappe. Subsequent measurements of flow on the prototypes with a current meter agree with model data to about 5%.

(1210) (a) LAWS OF SIMILARITY AS APPLIED TO MODEL TESTS: (A) SCALE EFFECT ON SPILLWAY SECTIONS. (b) National Bureau of Standards. (c) General research. (d) K. H. Beij, E. Hermansen, H. N. Eaton. (e) The Director, National Bureau of Standards. (f) To determine the conditions under which the laws of similarity are valid in the conduct of model tests for engineering purposes. (A) Study of generalized and special weir sections to determine scale effect. (g) The effects of size, surface roughness, shape of approach channel, etc., on the head-discharge relationship for a generalized weir section with no discontinuities will be determined. The equation for this section is $y/a = (1 - (x/\ell)^2)^2$, where y is the ordinate measured upward from the level of the approach-channel bed, x is the abscissa measured from the center-line of the section, and a and ℓ are parameters. For the first series of weirs, $a = \ell$, and for the weir now under test, $a = \ell = 20$ cm. The shape of this generalized weir section is a very close approximation to the curved portion of the other weir sections, including those most important from an engineering standpoint. (h) Further work is waiting on completion of an 18-inch glass-walled flume.

(1327) (a) SILVER LAKE SIPHON SPILLWAY. (b) U. S. Geological Survey. (c) Model study of round-crested weir. (d) E. Hermansen, C. W. Elliot, H. N. Eaton (National Bureau of Standards), O. W. Hartwell (U. S. Geological Survey). (e) The Director, National Bureau of Standards. (f) To obtain from a model the head-discharge relationship for the prototype when it is acting as a weir, that is, when it is not flowing full as a siphon. (g) A simplified, full-size model was calibrated in a 12-ft wide flume. (h) The tests have been completed on the weir and the report written. Plans have been completed to build a 1:3 model to be calibrated as a siphon.

(1328) (a) CONDENSING WATER CIRCULATION. (b) Navy Department, Bureau of Ships. (c) Model study of circulation of hot water discharged from a testing laboratory into a nearly closed ship basin. (d) Laboratory staff. (e) The Director, National Bureau of Standards. (f) To determine rise of temperature at intake of laboratory circulation system; to determine best location of outlet of laboratory circulation system; and to determine other pertinent data disclosed by model tests. (g) A model of the ship basin on a scale of 1:80 was constructed. Provision was made for simulating tides. Hot-water circulation systems representing two laboratories in operation and the proposed laboratory, with provision for maintaining any desired discharges and temperatures were installed. Twenty-four thermocouples and eight thermometers were used for measuring temperatures. Travel of hot water in the basin was observed and photographed using milk as a dye. (h) Tests are completed and preliminary reports have been submitted. A final comprehensive report is being prepared for record.

BEACH EROSION BOARD. Office of the Chief of Engineers, War Department.

(1196) (a) CHARACTERISTICS OF POSITIVE TRANSLATION WAVES. (b) Beach Erosion Board and National Bureau of Standards. (c) Research. (d) M. A. Mason (Beach Erosion Board), G. H. Keulegan (National Bureau of Standards). (e) Captain W. C. Hall. (f) To compare theoretical with observed characteristics of translation waves. (g) Comparisons are made of velocity of propagation, shape and damping of waves. (h) Computations are in progress.

(1329) (a) DEVELOPMENT OF ELECTRIC WAVE PROFILER. (b) Laboratory research. (c) Laboratory project. (d) M. A. Mason and J. V. Hall, Jr. (e) Captain W. C. Hall. (f) To develop by the use of a recording oscillograph a reliable method of simultaneously determining all wave characteristics, including profile and direction, for use in wave tank or ocean studies. (g) Determination of a straight-line variation of band with wave height for single oscillograph elements in the wave tank. (h) Experiment in progress.

(1330) (a) STUDY OF OSCILLATORY WAVES PROPAGATED IN A UNIFORMLY DECREASING DEPTH OF WATER. (b) Laboratory research. (c) Laboratory project. (d) M. A. Mason and J. V. Hall, Jr. (e) Captain W. C. Hall. (f) To study the characteristics of oscillatory waves propagated in a uniformly decreasing depth of water. To compare theoretical and measured wave length, wave velocity, wave profile, orbital velocity and mass transfer for waves covering the possible range of period and wave height. (g) Waves are generated by a displacement-type wave generator in a wave tank with a uniformly shoaling bottom. Characteristics are measured under steady conditions. (h) Development of measuring technique employing high-speed photography and electric wave-profiler in progress.

(1331) (a) STUDY OF THE CHARACTERISTICS OF DEEP AND SHALLOW-WATER OCEAN WAVES. (b) Research. (c) Field project. (d) M. A. Mason and J. V. Hall, Jr. (e) Captain W. C. Hall. (f) To study in the field the characteristics of deep and shallow-water waves. (g) An echo sounder employed with numerous transmitters and receivers placed on the bottom of the ocean is to be used to profile the waves as they approach the beach. A study of the wave characteristics will be made from the record. (h) Development of apparatus in progress.

U. S. ENGINEER OFFICE (Los Angeles, War Department).

(1332) (a) HYDRAULIC MODEL STUDY OF CHANNEL IMPROVEMENTS FOR LOS ANGELES RIVER FROM ABOVE DAYTON AVENUE TO FOURTH STREET, LOS ANGELES, CALIFORNIA. (b) The District Engineer, U. S. Engineer Office, Los Angeles, California. (c) Model study of an open channel to be used for routing floodwaters through restricted right-of-way within industrial and business districts of the metropolitan area of Los Angeles. The proposed channel construction comprises a series of reaches wherein the cross sections are either rectangular or trapezoidal, separated by necessary transitions. Numerous multiple-span highway and railroad bridges cross the stream. (d) Experiments conducted by A. P. Gildea, Associate Engineer, and laboratory staff, under the general supervision of James G. Jobes, Senior Engineer. (e) The District Engineer, U. S. Engineer Office, Los Angeles, California. (f) To determine the adequacy of the proposed channel improvements, to investigate alternate designs, and to study the losses incurred by bridge-pier obstructions in the channel. (g) The model, which includes the reach from above Dayton Avenue to Fourth Street, is constructed to a 1-to-50 undistorted scale and simulates about 19,500 feet of prototype channel. The study involves the determination of all features of open-channel design with especial emphasis on wall heights, channel sections, velocity distribution, super-elevation in curves and energy losses through bridge sections. The design discharge is 104,000 cfs, and velocities are generally supercritical. (h) All model tests are completed and preparation of the final report is in progress.

(1333) (a) HYDRAULIC MODEL STUDY OF SPILLWAY AND OUTLET WORKS FOR SANTA FE FLOOD CONTROL DAM, SAN GABRIEL RIVER, CALIFORNIA. (b) The District Engineer, U. S. Engineer Office, Los Angeles, California. (c) Model study of control structures for flood control dam. The dam, [illegible],000 feet long and 92 feet high, will be of the rolled earth-fill type, with concrete overflow spillway 1,200 feet long designed to pass safely a discharge of 200,000 cfs under a maximum head of 12 feet. The outlet works will consist of 16 gated conduits having a combined capacity of 37,000 cfs under a head of 75 feet. The controlled outflow for the design flood is to be 1[illegible],000 cfs. (d) Experiments conducted by A. P. Gildea, Associate Engineer, and laboratory staff, under the general supervision of James G. Jobes, Senior Engineer. (e) The District Engineer, U. S. Engineer Office, Los Angeles, California. (f) To determine the shape of the spillway and approach channel, best means of protection against erosion at toe of spillway by a stilling basin, and the proper design of the conduit outlet structure and outlet stilling basin. (g) Three models have been constructed: (1) a 1:20-scale model of a section of the spillway constructed in a glass-sided flume which permitted the simulation of a 53.3-foot width of the prototype structure including a 200-foot length of the approach channel, the spillway, and stilling basin, and a 260-foot length of the channel bed downstream from the stilling basin. (2) a 1:70-scale general spillway model including about a quarter of the dam and reservoir, 1,600 feet of the stream channel above the reservoir, the spillway and stilling basin, (3) a 1:32-scale model of the outlet works including intake structure, conduits, stilling basin and a portion of the river channel below the stilling basin. (h) All model tests are completed and preparation of the final report is in progress.

BONNEVILLE HYDRAULIC LABORATORY (War Department).

(917) (a) MODEL STUDY OF THE SPILLWAY FOR MUD MOUNTAIN DAM. (b) The Division Engineer, North Pacific Division, Portland, Oregon. (c) Study of a spillway structure. (d) Laboratory staff under the direction of Robert B. Cochrane, Hydraulic Engineer. (e) The Resident Engineer, U.S. Engineer Office, Bonneville, Oregon. (f) To determine the hydraulic characteristics of the spillway as originally designed, and to develop means of correcting any undesirable features. (g) The model was constructed to a scale of 1:50, with the spillway structure built of waterproofed plywood and the dam, upper pool, and downstream canyon reproduced in concrete. Observations of spillway capacity, water-surface profiles, velocities, pressures, and general flow conditions were made. (h) All testing has been completed. The results of these tests have been presented in four preliminary reports dated September 1, 1939, December 1, 1939, February 1, 1940, and September 21, 1940, (i) A final report covering the results of the entire model study will be issued within the next three months.

(1106) (a) MODEL STUDY OF THE NAVIGATION CHANNEL CONDITIONS ON THE COLUMBIA RIVER AT BONNEVILLE, OREGON. (b) The District Engineer, U. S. Engineer Office, Portland, Oregon. (c) Study of plans for improving navigation channel conditions. (d) and (e) See (917). (f) To determine the most satisfactory plan for the elimination of undesirable current conditions at the entrance to the downstream approach channel of the Bonneville Navigation Lock. (g) The model, of the fixed bed type, was constructed to a horizontal scale of 1:200 and a vertical scale of 1:100, and reproduced a five-mile reach of the Columbia River below Bonneville Dam. Flows from low water to maximum flood were simulated, especial attention being given to flows greater than 300,000 cfs. The plans tested involved realignment of the north shore of the main channel and realignment of the south shore of the lock approach channel, in conjunction with the enlargement of the powerhouse tailrace, and the deepening of the lock approach channel, Observations of current directions, velocities, and water-surface profiles were made. (h) All testing has been completed. A final report covering the results of the entire model study will be issued within the next six months.

(1107) (a) MODEL STUDY OF 23-FT OUTLET TUNNEL FOR MUD MOUNTAIN DAM. (b) The Division Engineer, North Pacific Division, Portland, Oregon. (c) Study of a tunnel structure. (d) and (e) See (917). (f) To ascertain the hydraulic characteristics of the designed tunnel and to develop means of correcting any unsatisfactory features. (g) The model was constructed to a scale of 1:25. The intake structure, the tunnel proper, the penstocks and regulating valves, and the canyon topography in the vicinity of the tunnel inlet and outlet were reproduced in the model. The penstocks and regulating valves were replaced by the diversion tunnel in the latter part of the study. The tunnel proper was made of pyralin to permit observation of flow conditions. (h) All testing has been completed, rating curves for the tunnel established, and all the required data on pressures and general flow characteristics taken. The results of all tests have been presented in preliminary reports dated July 24, August 23, September 6, October 22, and November 5, 1940. (i) The preparation of the final report is now in progress and will be issued in January, 1942.

(1108) (a) MODEL STUDY OF THE WILLAMETTE FALLS LOCKS, OREGON CITY, OREGON. (b) The District Engineer, U. S. Engineer Office, Portland, Oregon. (c) Study of the operation of a system of two locks. (d) and (e) See (917). (f) To study the operation characteristics of the designed lock system, and to determine what changes, if any, may be required to increase the efficiency of these structures. (g) The model was constructed in plywood and pyralin to a scale of 1:25. The upstream or guard lock, the main lock, the intervening lock basin, the siphon spillway, and portions of the upper and lower pools were reproduced. One unit of the siphon spillway was also reproduced to scales of 1:10, 1:20, and 1:30 to study better the action of that structure. (h) All testing has been completed. A final report incorporating the results of the model study was issued on June 10, 1941.

(1109) (a) SPILLWAY PRESSURE HEAD INVESTIGATION, BONNEVILLE SPILLWAY DAM, BONNEVILLE, OREGON. (b) The Division Engineer, North Pacific Division, Portland, Oregon. (c) Comparison of prototype and model pressures on spillway ogee section. (d) and (e) See (917) (f) To determine the pressure conditions on the crest and downstream face of the Bonneville Spillway Dam, and to compare with the results of a previously conducted model study, special attention being paid to negative pressures. (g) A series of observations were conducted on one of the bays of the Bonneville Spillway Dam during low tailwater conditions. Water-surface elevations below the gate and pressures on the face of the ogee section were taken with the gate on the crest of the spillway set at various openings in both the upstream and downstream slot. A comparison was made between these observations and similar observations taken on the 1:5 scale model of this spillway which was studied at the Hydraulic Laboratory at Linnton, Oregon, during the period of April 1935 to January 1937. (h) A final report on this investigation was issued July 25, 1941.

(1334) (a) MODEL STUDY OF SPILLWAY AND OUTLET WORKS, DORENA DAM, ROW RIVER, OREGON. (b) The District Engineer, U. S. Engineer Office, Portland, Oregon. (c) Study of a spillway structure and outlet works. (d) and (e) See (917). (f) To determine the hydraulic characteristics of the spillway and outlet works as originally designed, and to develop means of correcting any undesirable features. (g) The model was constructed to a scale of 1:50, and the following items reproduced: the dam, upper pool, and tailbay in concrete, the spillway structure of waterproofed plywood; and the intake structure and tunnel of pyralin. (h) All testing has been completed. The preparation of the final report is now in progress.

U. S. WATERWAYS EXPERIMENT STATION (War Department).

(415) (a) MISSISSIPPI RIVER FLOOD CONTROL MODEL. (b) The President, Mississippi River Commission, Vicksburg, Miss. (c) Model study of flood-control plans. (d) Personnel of U. S. Waterways Experiment Station under the general supervision of the Director of the Station. (e) The Director, U.S. Waterways Experiment Station. (f) To test the effectiveness of various flood-control plans for improvement of the Lower Mississippi River. (g) The model is of the fixed-bed type with scale ratios: horizontal dimensions, 1 to 2000; vertical dimensions, 1 to 100. Reproduced in the model are: the main channel of the Mississippi River from Helena, Arkansas (mile 300 below Cairo, Illinois), to Donaldsonville, Louisiana (mile 900 below Cairo, Illinois); the entire Atchafalaya Basin as far south as the Gulf of Mexico; and the backwater areas of the Arkansas, White, Yazoo, Ouachita, and Red Rivers. (h) Additional tests of the study of flow lines for review of the Mississippi River project were made. A study of the flow distribution at the latitude of Old River was in progress.

(643) (a) MODEL STUDY OF MANCHESTER ISLANDS REACH, OHIO RIVER (MILE 394.6 TO MILE 396.8 BELOW PITTSBURGH, PENNSYLVANIA). (b) The District Engineer, U. S. Engineer Office, Cincinnati, Ohio. (c) Study of proposed channel improvements. (d) and (e) See (415). (f) To determine the effectiveness of various plans proposed for the permanent improvement of navigation conditions in the vicinity of the Manchester Islands. (g) The model was of the movable-bed type with scale ratios: horizontal dimensions, 1 to 300; vertical dimensions, 1 to 80. Reproduced was that reach of the Ohio River from mile 392 to mile 400 below Pittsburgh, Pennsylvania, with the adjacent overbank area. In this reach two islands divide the Ohio River into three channels, two of which are either too narrow or too shallow for navigation at normal stages. The third channel (on the Kentucky side of the river) is used for navigation at all except high-river stages, but requires excessive dredging for maintenance. (h) A detailed description of the model tests and results is contained in the final report, Technical Memorandum No. 181-1, entitled "Model Study of Plans for Elimination of Shoaling in the Vicinity of the Manchester Islands, Ohio River," which may be obtained on a loan basis from the Experiment Station Library.

(786) (a) DETERMINATION OF THE TOPMOST FLOWLINE AND MEASUREMENT OF PRESSURES IN THE SUPPLEMENTARY DAM AT THE U.S. WATERWAYS EXPERIMENT STATION. (b) The Soils Laboratory. (c) Scientific research. (d) and (e) See (415). (f) To determine the variation in the position of the topmost flowline in the structure, and to observe the distribution of pressure in the foundation with Goldbeck pressure cells. (g) Biweekly observations of the wells are made to add to the general fund of knowledge concerning seepage through such structures. Semiannual observations of the Goldbeck pressure cells are made. (h) The observations are being continued.

(793) (a) MODEL STUDY, FLOOD-CONTROL PRPJECT, JOHNSTOWN, PENNSYLVANIA. (b) The District Engineer, U. S. Engineer Office, Pittsburgh, Pa. (c) Model study of flood-control plans. (d) and (e) See (415). (f) To determine the most economical and effective design for the improvement of the channel of the Conemaugh River, Stony Creek, and the Little Conemaugh River, in the vicinity of Johnstown, Pa., so that floods of the magnitude of that of March 17-18, 1936, would be carried within banks. (g) The model is of the fixed-bed type with scale ratios: horizontal dimensions, 1 to 200; vertical dimensions, 1 to 80, and reproduces 5.8 miles of Stony Creek, 216 miles of the Little Conemaugh River, and 4.7 miles of the Conemaugh River, with sufficient overbank to include all areas considered in danger of possible flooding. The model was so constructed that the effects of bridge piers, curves, changes in section, roughness of wall and bed, etc., are represented in correct ratio. (h) Additional tests of improvement plans were requested from time to time by the District Engineer. Preparation of the final report is in progress.

(969) (a) MODEL STUDY OF WAVE FORCE AGAINST BREAKWATERS (b) The Division Engineer, Great Lakes Division, Cleveland, Ohio. (c) Model study of distribution and intensity of wave forces. (d) and (e) See (415). (f) To develop vertical pressure curves (showing the pressures resulting from waves striking against breakwaters) to be used as a basis for the design of breakwaters. Four variables will be investigated and the resulting vertical pressure curves developed. These variables are: (1) heights and lengths of waves; (2) depth of water and slope of bottom; (3) shape of breakwater; and (4) angle of impingement of waves. (g) The investigation is being conducted in a 5- x 18- x 117-ft, reinforced-concrete tank, equipped with a 4- by 6-ft viewing window in tank side at breakwater. A plunger-type wave machine capable of producing a 1-ft wave is used. Water pressure is measured by a bank of specially developed pressure cells and recorded, simultaneously with wave heights, on a seven-element oscillograph. Wave heights are determined by means of an electric wave-height measuring device developed at the Experiment Station. (h) Construction and calibration of tank, wave machine, and appurtenances have been completed. Tests to determine the magnitude and shape of the vertical pressure curves for waves forming a clapotis at a vertical breakwater are in progress. (i) The resulting pressure curves are being compared with M. Sainflou's method of computing pressures for the clapotis formed by shallow-water waves.

(1141) (a) MODEL STUDY OF PLANS FOR THE ELIMINATION OF SHOALING IN RICHMOND HARBOR, JAMES RIVER. (b) The District Engineer, U. S. Engineer Office, Norfolk, Va.(c) Model study of plans for the elimination of shoaling. (d) and (e) See (415). (f) (1) To determine the effects of proposed improvement works upon shoaling in Richmond Harbor, and upon flood heights through and upstream from the harbor; and (2) to develop such other plans of improvement as might be suggested during the course of the study. (g) Richmond Harbor is located at the head of tidewater (the upper limit of navigation) in the James River. The upper end of the harbor is, in effect, a sediment basin since at this point flows from the steep upper river meet the relatively level pool at the head of tidewater. As a result the harbor shoals rapidly, necessitating a continual dredging program. The model was of the movable-bed type with scale ratios: horizontal dimensions, 1 to 72; vertical dimensions, 1 to 36. Reproduced was the James River from the head of tidewater to 1 mile below the City of Richmond locks. Provisions were made for the introduction of the fresh-water discharge at the upper end of the reach, and for the automatic reproduction of tidal effects at the lower end of reach. (h) A detailed description of the model tests and results is contained in the final report, Technical Memorandum No. 178-1, entitled "Model Study of Plans for Elimination of Shoaling in Richmond (Virginia) Harbor in James River," which may be obtained on a loan basin from the Experiment Station Library.

(1142) (a) MODEL STUDY OF CHANNEL IMPROVEMENT, FLOOD-CONTROL PROJECT, HORNELL, NEW YORK. (b) The District Engineer, U. S. Engineer Office, Binghamton, N. Y. (c) Model study of channel improvement plans for flood control. (d) and (e) See (415). (f) To supplement and verify hydraulic design computations for determination of final detailed design plans for the channel improvement of Canisteo River, Canacadea Creek, and Chauncey Run, at Hornell, New York. (g) The Southern New York Flood Control project provides for the construction of detention reservoirs and related flood-control works for the protection of Hornell and other towns in New York and Pennsylvania. At Hornell the work consists of channel improvement by the construction of levees and flood walls and the widening and deepening of Canisteo River, Canacadea Creek, and minor channels. The Canisteo River channel is designed to discharge 21,000 cfs and the Canacadea Creek channel, 8000 cfs. The 1- to-40-scale fixed-bed model reproduced 10,800 ft of Canisteo River, 3600 ft of Canacadea Creek, and 700 ft of Chauncey Run. Drop structures and weirs were included in the reaches reproduced. (h) A detailed description of the model tests and results is contained in the final report, Technical Memorandum No. 170-1, entitled "Model Study of Plans for Improvement of the Channels of Canisteo River and Canacadea Creek, Hornell, New York, " which may be obtained on a loan basis from the Experiment Station Library.

(1143) (a) MODEL STUDY OF CHANNEL IMPROVEMENT, ABSECON INLET, ATLANTIC CITY, NEW JERSEY. (b) The District Engineer, U. S. Engineer Office, Philadelphia, Pa. (c) Model study of plans for improvement of navigable channel. (d) and (e) See (415). (f) To determine the effects of several proposed jetty designs at the mouth of Absecon Inlet with special attention to their efficacy in maintaining a ship channel, and their probable effect on the beaches at Atlantic City, (g) The project for Absecon Inlet (the entrance to the harbor at Atlantic City) provides for obtaining and maintaining an entrance channel 20 ft deep and 400 ft wide at m.lw. However, should the channel at any time have a deleterious effect on the Atlantic City beach, the project will be discontinued since preservation of the beach takes precedence over improvement of the inlet. The model is of the movable-bed type with scale ratios: horizontal dimensions, 1 to 500; vertical dimensions, 1 to 100. The movable-bed reach extends from Ventnor, N. J., to a point on Brigantine Beach 22,000 ft northeast of Absecon Inlet. Provisions have been made for reproducing waves from any direction between south and east, tides of any type, and littoral current either up or down the beach. (h) Verification of the model has been completed; testing of proposed improvement plans if in progress.

(1144) (a) MODEL STUDY OF TUNNEL NO. 1, FORT PECK DAM. (b) The Division Engineer, Missouri River Division, Kansas City, Mo. (c) Model study of the hydraulic characteristics of the power tunnel. (d) and (e) See (415). (f) (1) To investigate surge phenomena in Tunnel No. 1 resulting from turbine-gate operation, and to evaluate the effects of the main control shaft upon these phenomena; (2) to determine the relative efficiencies of four shapes of Y-branches for the penstocks; and (3) to make tests of practical value for the design of the prototype surge-tank installation. (g) The 1-to-20-scale model, approximately 250 ft in length, included the intake structure, emergency control shaft, main control shaft, Y-branch, penstocks, and surge tanks. Each penstock was fitted with avalve mechanically operated so as to simulate turbine-gate closure. The model was constructed of transparent pyralin. Instantaneous measurement of pressure waves and surges at

critical points was accomplished by means of pressure cells and electrodes in circuit with a seven-element oscillograph. Pressure gradients and energy losses were determined by means of piezometers. (h) A detailed description of the model tests and results is contained in the final report, Technical Memorandum No. 185-1, entitled "Model Study of Hydraulic Characteristics of Power Tunnel, Fort Peck Dam," which may be obtained on a loan basis from the Experiment Station Library.

(1145) (a) MODEL STUDY OF STRUCTURES FOR FUTURE POWER DEVELOPMENT, FRANKLIN FALLS DAM. (b) The District Engineer, U. S. Engineer Office, Boston, Mass. (c) Model study of powerhouse forebay, and appurtenant structures. (d) and (e) See (415). (f) To investigate the adequacy of the design of the powerhouse forebay and appurtenant structures, and to develop improvements therein, if necessary, with respect to the following requirements; (1) efficient functioning for power developments; (2) safe passage of full tunnel flow with intake gates inoperative; and (3) no interference of tailrace discharge with proper stilling-basin action. (g) Franklin Falls Flood-Control Reservoir will be located on the Pemigewasset River, the main tributary of the Merrimack River, near Franklin, New Hampshire. Flows will be passed over a 550 ft spillway or through gate-controlled outlet conduits. For possible future power development, it is proposed to divert water from the reservoir through a 23-ft-diameter tunnel into a forebay. From the lower end of the forebay, the water will pass through two 16-ft-diameter penstocks, one to each of two vertical Kaplan turbines, and return through a tailrace channel to the river immediately below the flood-control-outlet stilling basin. Flow from the tunnel into the forebay in excess of turbine capacity is to be passed over a weir at the lower end of the forebay discharge channel. The 1-to-25-scale model included the tunnel, forebay, forebay weir, penstocks, tailrace, two short portions of the flood-control conduits, flood-control-outlet stilling basin, and 400 ft of the exit channel. The maximum discharge required for the turbines is 3200 cfs; however, the tunnel, forebay, and forebay weir must be able to pass safely a discharge of approximately 20,000 cfs. (h) A detailed description of the model tests and results is contained in the final report, Technical Memorandum No. 165-1, entitled "Model Study of Structures for Future Power Development for the Franklin Falls Dam, Pemigewasset River, New Hampshire," which may be obtained on a loan basis from the Experiment Station Library.

(1147) (a) MODEL STUDY OF PLANS FOR THE ELIMINATION OF SHOALING, VICINITY OF THE HEAD OF PASSES, MISSISSIPPI RIVER (b) The District Engineer, U. S. Engineer Office, New Orleans, La. (c) Model study of plans for channel improvement. (d) and (e) See (415). (f) To study and develop plans for the improvement and maintenance of the deep-water channel from Head of Passes to the Gulf of Mexico through Southwest Pass. (g) The Mississippi River flows into the Gulf of Mexico through several natural outlets, of which only South and Southwest Passes are suitable for deep-water navigation. The entrance channel at the head of Southwest Pass, however, requires annual maintenance dredging; plans for elimination of this dredging are being studied. The model is of the movable-bed type with scale ratios: horizontal dimensions, 1 to 500; vertical dimensions, 1 to 150. Reproduced are 7 miles of the Mississippi River above the Head of Passes, all of South and Southwest Passes, and the upper 2 miles of Pass a l'Outre and of Cubits Gap. Cubits Gap and Pass a l'Outre may be regulated to discharge any desired percentage of the flow, while South and Southwest Passes are controlled by maintaining the water-surface elevations at mean Gulf level at their lower ends. These water-surface elevations are controlled by electrically-operated automatic valves which replace tailgates in this model. (h) Verification tests have been completed; tests of proposed improvement plans are in progress.

(1150) (a) HYDROLOGICAL RESEARCH PROJECT. (b) The Chief of Engineers, U. S. Army, Washington, D.C. (c) Scientific investigation of general hydrological phenomena. (d) and (e) See (415). (f) To augment pertinent data and to advance the knowledge of the hydrological characteristics of any drainage basin through a comprehensive study of the hydrology of a typical small watershed - that of the Experiment Station lake. (g) Three investigations are included in the project: (1) a study of the rainfall-runoff relationship, using the unit hydrograph method; (2) a study of evaporation; and (3) a study of wave formation. The apparatus and structures used consist of: 23 non-recording and 5 recording rain-gaging stations located at approximately 1/2 mile intervals over the 5-1/2 square mile watershed; 6 inflow stream-gaging stations and one outflow gaging station; one land and one floating evaporation station; wave-height, wind-velocity and wind-direction measuring and recording devices; and 6 ground-water wells. (h) Installation of the major portion of the equipment has been completed and the collection and tabulation of data are in progress.

(1225) (a) MODEL STUDY OF EXPERIMENT STATION LAKE SPILLWAY AND DURDEN CREEK CHANNEL. (b) The President, Mississippi River Commission, Vicksburg, Miss. (c) Model study of spillway and channel improvements. (d) and (e) See (415). (f) To detect and determine means of correcting all unsafe or undesirable conditions that exist; and to obtain data for use in connection with the hydrological survey of the Experiment Station lake drainage area. (g) The Experiment Station lake is impounded by a dam 450 ft long and 20 ft high. Normal flow from the lake is controlled by a 7-ft diameter conduit through the dam, having a maximum capacity of 550 cfs. Flood flows pass over a chute-type spillway (crest length 120 ft) in the east abutment of the dam. The spillway and conduit discharge into Durden Creek which flows through the Experiment Station grounds. The 1-to-25 scale model is molded of concrete and has the proper surface roughness. Provisions have been made for a movable-bed section immediately below the stilling basin. The model includes 240 ft of the approach to the spillway, the spillway, stilling basin, conduit exit, and 890 ft of exit channel. (h) Model tests of Durden Creek channel improvements were completed.

(1226) (a) MODEL STUDY OF THE MILL CREEK FLOOD-CONTROL PROJECT, CINCINNATI, OHIO. (b) The District Engineer, U. S. Engineer Office, Cincinnati, Ohio. (c) Model study of flood-control plans. (d) and (e) See (415). (f) To study the hydraulic performance of structures proposed for the protection of Cincinnati, Ohio, from Ohio River floods. (g) This study involves the proposed levee and flood wall to be constructed across Mill Creek to prevent Ohio River flood water from backing up into the creek valley, and a barrier dam and pumping station for the purpose of discharging the flood waters of Mill Creek during high water in the Ohio River. The barrier dam is to be equipped with a gate-controlled discharge bay which will furnish an outlet for Mill Creek during normal stages in the Ohio River. The dam will also contain the nine pump units of the pumping station. Each pump is designed to discharge a maximum of 2000 cfs. Two fixed-bed models were used in the study. (1) A 1-to-50-scale model reproduced about 3100 ft of Mill Creek from its confluence with the Ohio River to a point 100 ft north of Cest Street Bridge. Although the model was built of concrete, it was so constructed that alterations could be made to reproduce either the existing channel or conditions with the barrier dam in place. Investigations were made of discharges up to 76,000 cfs. (2) A 1-to-25-scale model reproduced Mill Creek in the vicinity of the proposed barrier dam. The model was so constructed that changes in design of the dam and pumphouse could be easily introduced. Investigations were made with discharges up to 18,000 cfs. (h) All tests have been completed; preparation of the final report is in progress.

(1229) (a) MODEL STUDY OF THE SPILLWAY, DENISON DAM, RED RIVER. (b) The District Engineer, U. S. Engineer Office, Denison, Texas. (c) Model study of spillway performance. (d) and (e) See (415). (f) To investigate the hydraulic capacity of the spillway, to improve flow characteristics, and to attempt to effect economies in design. (g) The Denison Dam spillway will be located in a saddle to the south of the control structures and is designed to pass a flood of 750,000 cfs with a head of 21.7 ft. The chute-type spillway (crest length, 2000 ft) will be curved in plan to a 2400-ft radius. Below the crest the spillway will converge and drop about 125 ft into a stilling basin also curved in plan. The spillway discharge will flow from the stilling basin into Shawnee Creek by way of a shallow exit channel. The 1-to-80-scale model reproduced 2500 ft of approach channel, a portion of the earth embankment, the spillway proper, the stilling basin, the exit channel, and about 2500 ft of the Shawnee Creek area below the exit channel. (h) A detailed description of the model tests and results is contained in the final report of the study, Technical Memorandum No. 177-1, entitled "Model Study of the Spillway, Denison Dam, Red River," which may be obtained on a loan basis from the Experiment Station Library.

(1231) (a) MODEL STUDY OF PLANS FOR ELIMINATION OF SHOALING IN WILMINGTON HARBOR, CHRISTINA RIVER, DELAWARE. (b) The District Engineer, U. S. Engineer Office, Philadelphia, Pa. (c) Model study for elimination of shoaling. (d) and (e) See (415). (f) To develop a plan which will eliminate or reduce shoaling in Wilmington Harbor, Delaware. (g) Wilmington Harbor consists of a channel 400 ft wide by 30 ft deep in the Christina River near its mouth. Flood tides bring silt from the Delaware River into the Christina River at Wilmington Harbor, where the silt is deposited. Subsequent ebb tides create currents of such small magnitude that the silt is not carried back into the Delaware. Therefore extensive dredging is necessary to maintain project dimensions in the Christina River. The model was an extension of the Chesapeake and Delaware model (see No. 970 in the January 1941 Bulletin) and included the Delaware River from 5 miles above Wilmington to Artificial Island, the Christina River from its mouth to the head of tidewater, and the Brandywine River, from its confluence with the Christina to the head of tidewater. Tides and currents were reproduced by automatic tide gages - one at Artificial Island, and the other about 5 miles above Wilmington. (h) Design, construction, and operation of the model are complete; preparation of the final report is in progress.

(1232) (a) MODEL STUDY OF PLANS FOR ELIMINATION OF SHOALING IN DEEPWATER POINT RANGE, AND NEW CASTLE AND FINNS POINT RANGES, DELAWARE RIVER. (b) The District Engineer, U. S. Engineer Office, Philadelphia, Pa. (c) Model study of shoaling elimination. (d) and (e) See (415). (f) To test plans proposed for reducing shoaling in the Deepwater Point range, and New Castle and Finns Point ranges of the Delaware River ship channel. (g) The project provides for a channel about 96 miles long and of various specified dimensions extending from Philadelphia to deep water in Delaware Bay. These dimensions are to be obtained by the construction of dikes and training walls and by dredging. Deepwater Point Range shoals at an average annual rate of nearly 2,800,000 cu yd, while New Castle and Finns Point Ranges together shoal at an average annual rate of about 2,000,000 cu yd. The Chesapeake and Delaware Canal model (see No. 970 in the January 1941 Bulletin) as revised for the Wilmington Harbor model study (see above) is being used for these studies. (h) Testing of the plans proposed for Deepwater Point Range has been completed. Tests of plans proposed for elimination of shoaling in New Castle and Finns Point Ranges are in progress.

(1233) (a) MODEL STUDY OF SAVANNAH RIVER HARBOR ENTRANCE. (b) The District Engineer, U. S. Engineer Office, Savannah, Ga. (c) Model study of channel improvements. (d) and (e) See (415). (f) To study means of improving and maintaining the ship channel from Savannah, Georgia, to deep water in the Atlantic Ocean, consideration being given to the protection and maintenance of adjacent recreation beaches. (g) Proposed improvements of Savannah Harbor include revision of existing jetties at the mouth of the Savannah River, the relocation of the inland waterway through the harbor, and the enlargement of the ship channel at various points. The model is of the fixed-bed type with scale ratios: horizontal dimensions, 1 to 1000; vertical dimensions, 1 to 150. Reproduced are the Savannah River from the head of tidewater to the mouth, and all areas in the vicinity of the mouth which are subject to tidal flow. Two automatic tide controls are used for tidal reproduction. (h) Design, construction, and hydraulic adjustment of the model have been completed, and tests of improvement plans are in progress.

(1235) (a) STUDY OF THE MEANDERING OF MODEL STREAMS. (b) The President, Mississippi River Commission, Vicksburg, Miss. (c) Model study of the characteristics of meandering streams. (d) and (e) See (415) (f) To study the meandering of model streams. (g) The movable bed study is being conducted in a 133 ft x 41.5 ft flume which has an unobstructed bed area of 125 ft by 40 ft. The flume is spanned by a steel-trussed walkway which may be rolled, on an adjustable grade track, the entire length of the flume. A 20-ft-high photographic tower mounted on rollers can be placed on the walkway and moved to any location on the model. Machined bars and molding templates attached to the upper and lower chords, respectively, of one truss of the walkway facilitate the molding of the model bed and the obtaining of water-surface and bed elevations. Crushed coal is being used at present as the movable-bed material. (A study is being made in a small supplementary flume to determine the feasibility of using other types of bed material in the large flume.) Prior to each test series in the large flume, a straight channel is molded along the center line of the flume. A short section of fixed channel is placed at the entrance and alined to give an angular direction to the flow. During operation the stream is allowed to meander at will. The data obtained consist of soundings, water-surface profiles, photographs, and observations of bed-load movement. (h) Preliminary tests have been completed; testing of practical river problems is in progress.

(1236) (a) MODEL STUDY OF WAVE ACTION, GRAND MARAIS HARBOR, MINNESOTA. (b) The District Engineer, U. S. Engineer Office, Duluth, Minn. (c) Model study of wave action. (d) and (e) See (415). (f) To study wave action in Grand Marais Harbor with particular attention to the action within the proposed small-craft harbor along the west shore. (g) Grand Marais Harbor is a small natural indentation in the northwestern shore line of Lake Superior. The harbor does not provide sufficient area to damp waves entering between the present breakwaters at its entrance, and, as a result, storm waves make the harbor unsafe for small craft. To provide adequate protection, an inner harbor within the main harbor was proposed. The 1-to-100-scale model was of the fixed-bed type and reproduced all of Grand Marais Harbor and the adjacent shore lines. A plunger-type wave machine was used to generate waves from east, southeast, south, and southwest. Wave heights were measured by an electric measuring device; the primary lake waves range from 12 to 18 ft in height (prototype dimensions). (h) A description of the model tests and results is contained in the final report, Technical Memorandum No. 186-1, entitled "Model Study of Plans for the Reduction of Wave Action in Grand Marais Harbor, Minnesota," which may be obtained on a loan basis from the Experiment Station Library.

(1239) (a) MODEL TESTS ON CANTON RESERVOIR SPILLWAY AND INTEGRAL SLUICEWAYS. (b) The District Engineer, U. S. Engineer Office, Tulsa, Oklahoma. (c) Model study of spillway and sluiceway performance. (d) and (e) See (415). (f) (1) To analyze the hydraulic characteristics of the Canton Dam spillway, integral sluices, and spillway approach and exit channels, as designed; (2) to test certain proposed alterations in the design of these elements; and (3) to obtain the best flow conditions possible for the most economical and desirable design that could be developed. (g) Canton Dam, to be located on the North Canadian River near Canton, Oklahoma, will provide flood control in the North Canadian and Arkansas River valleys. Normal flows from the reservoir will pass through three 7- x 12-ft conduits through the center of a chute-type spillway adjacent to the right abutment of the dam. Sixteen 25- x 40-ft taintor gates surmounting the spillway will control extreme floods. The spillway is designed to pass a flow of 342,000 cfs under a head of 29 ft. Three models were used in this study. (1) A 1- to-24-scale section model reproduced two typical interior bays of the spillway without sluices or taintor gates. (2) A 1-to-27-scale section model of the two center bays of the spillway included a sluice, two crest gates, and a section of the stilling basin. The center crest-gate pier, through which the sluice passed, and the sluice were molded of transparent pyralin. (3) A 1-to-100-scale comprehensive model, incorporating changes in design indicated by the first two studies, was used for a general investigation of the control structures of the dam. (h) The testing program has been completed, and preparation of the final report is in progress.

(1335) (a) MODEL STUDY OF SALT-WATER INTRUSION IN THE LOWER MISSISSIPPI RIVER. (b) The District Engineer, U. S. Engineer Office, New Orleans, La. (c) Investigation of means of preventing the intrusion of salt water into the Lower Mississippi River. (d) and (e) See (415). (f) To study the action of the salt-water wedge; and to investigate plans for eliminating or delaying this intrusion of salt water from the Gulf of Mexico into the lower reaches of the Mississippi River. (g) Salt-water intrusion into the Lower Mississippi River is effected during periods of low-water flow in the river, and at times it results in contamination of the water supply at New Orleans. A fixed-bed model was built in a glass flume to the following scale ratios: length, 1 to 10,000; width, 1 to 2,500; and depth, 1 to 60. Reproduced was a 50-mile reach of the Mississippi River from mile 970 to mile 1020 below Cairo, Ill. Since the model was built in a flume of fixed width, the width simulated was the average of the reach. The entire bed was molded to a modified thalweg profile of the reach being studied. Salt water colored with potassium permanganate was introduced from the bottom at the lower end of the flume and the requisite fresh-water flow was introduced at the upper end of the flume. The height and progress of the interface were determined by visual observation. (h) The tests proposed for this model have been completed. A plan is being considered, based on the test results, for building a larger-scale, fixed-bed model of a reach of the Lower Mississippi River for the further testing of plans for the prevention or delaying of salt-water intrusion.

(1336) (a) MODEL STUDY OF THE SPILLWAY AND STILLING BASIN, DEWEY DAM, JOHNS CREEK, KENTUCKY. (b) The District Engineer, U. S. Engineer Office, Huntington, W. Va. (c) Model study of spillway and stilling basin performance. (d) and (e) See (415). (f) To determine the protective measures necessary to insure the safety of the dam and appurtenant structures; and to investigate and design an efficient spillway that will pass the design discharge satisfactorily through the spillway and stilling-basin area. (g) Dewey Reservoir, to be located on Johns Creek (a tributary of the Big Sandy River), will be used to reduce flood heights in the Big Sandy and Ohio River valleys. The dam will be provided with an uncontrolled, chute-type spillway designed to discharge 22,800 cfs under a head of 25 ft. Ordinary flows will be regulated by outlet works (maximum capacity 5000 cfs) consisting of a three-gated intake structure, a 500-ft horseshoe-shaped conduit, and a stilling basin. The 1-to-50-scale model reproduced 1400 ft of approach channel, the dam proper, the spillway, outlet works, and 1000 ft of exit channel. (h) Design, construction, and operation of the model have been completed. Preparation of the final report is in progress.

(1337) (a) MODEL STUDIES OF SPILLWAY AND BUCKET, CENTER HILL DAM, TENNESSEE. (b) The District Engineer, U. S. Engineer Office, Nashville, Tennessee. (c) Model study of spillway and bucket performance. (d) and (e) See (415) (f) To analyze the hydraulic characteristics of the spillway and bucket, and to develop means of correcting any uneconomic, unsafe, or otherwise undesirable conditions which may exist in the proposed design. (g) Center Hill Reservoir, to be located on the Caney Fork River, is a unit of the flood-control plan for the Ohio and Mississippi River valleys. Provisions will also be made for the generation of power. Flow regulation will be afforded by six 7.5-ft diameter sluices through the spillway. Nine 38- x 50-ft taintor gates surrounding the spillway will be used to control extreme floods. The spillway is designed to pass a flow of 456,000 cfs under a head of 44 ft. Two models will be involved in this study: (1) a 1-to-40-scale section model of a central bay of the spillway with two adjacent half bays includes the bucket, and portions of the approach and exit channels, and (2) a 1-to-100-scale comprehensive model of the entire problem area. (h) Design and construction of the section model have been completed; the testing program is in progress. Design and construction of the comprehensive model have not been undertaken.

(1338) (a) SECTION-MODEL STUDY OF SPILLWAY AND BUCKET, DALE HOLLOW DAM, TENN. (b) The District Engineer, U. S. Engineer Office, Nashville, Tennessee. (c) Model study of spillway and bucket performance. (d) and (e) See (415). (f) To analyze the hydraulic characteristics of the spillway and bucket, and to develop means of correcting any uneconomic, unsafe, or otherwise undesirable conditions which may exist in the proposed design. (g) Dale Hollow Reservoir, to be located on the Obey River, is a unit of the flood-control plan for the Ohio and Mississippi River valleys. Provisions will also be made for the generation of power. Flow regulation will be afforded by five 7.5-ft diameter sluices through the spillway. Six 12- x 60-ft taintor gates surmounting the spillway will be used to control extreme floods. The spillway is designed to pass a flow of 159,000 cfs under a head of 24 ft. The 1-to-40-scale section model will reproduce a central bay of the spillway with adjacent half bays, and will include the bucket and portions of the approach and exit channels. (h) Design and construction of the model are in progress.

(1339) (a) MODEL STUDY OF STILLING BASIN, BLUESTONE DAM. (b) The District Engineer, U. S. Engineer Office, Huntington, W. Va. (c) Model study of cavitation action on baffle piers, and of stilling-basin performance. (d) and (e) See (415). (f) To determine the location and size of cavitation pockets around the baffle piers, and to develop moderate revisions in the present stilling-basin design. (g) Bluestone Reservoir, to be located on the New River near Hinton, West Virginia, will form one of the flood-control reservoirs for the Ohio River valley. Flow regulation will be afforded by two circular and eight rectangular sluices through the spillway section. Twenty-one vertical-lift gates surmounting the spillway crest will be used to control extreme floods. The spillway is designed to pass a flow of 430,000 cfs under a head of 30 ft. A secondary, or stilling weir, will be located 364 ft downstream from the axis of the dam in order to provide sufficient tailwater in the stilling basin for the formation of a hydraulic jump. The stilling basin has for its main features (a) a 44-ft horizontal apron, (b) two rows of baffle piers, 6.5 ft in height, and (c) a 7-ft end sill. The model is a 1-to-36-scale section model of a portion of the spillway chute, the stilling basin, and the secondary weir. (h) Design and construction of the model have been completed; tests are in progress.

(1340) (a) MODEL STUDIES OF SPILLWAY AND REGULATING SLUICES, WOLF CREEK DAM, KENTUCKY. (b) The District Engineer, U. S. Engineer Office, Nashville, Tenn. (c) Model studies of spillway and sluice performance. (d) and (e) See 415. (f) To analyze the hydraulic characteristics of the Wolf Creek spillway and sluice outlets, and to develop means of correcting any uneconomic, unsafe, or otherwise undesirable conditions which may exist in the proposed design. (g) Wolf Creek Reservoir, to be located on the Cumberland River, is a unit of the flood-control plan for the Ohio and Mississippi River valleys. Provisions also will be made for the generation of power. Flow regulation will be afforded by twelve 6-x4-ft sluices through the spillway. Ten 37- x 50-ft taintor gates surmounting the spillway will be used to control extreme floods. The spillway is designed to pass a flow of 535,000 cfs under a head of 44 ft. Three models are involved in this study. (1) A 1-to-40-scale section model of a central bay of the spillway with two adjacent half bays includes two pairs of sluices, the bucket, and portions of the approach and exit channels. (2) A 1-to-15-scale model of one pair of sluices, reproduces the sluices and sluice gates, and a portion of the spillway face and bucket downstream from the sluices. The reservoir and approach channel are simulated by a steel pressure chamber. And (3) a 1-to-100-scale comprehensive model of the entire problem area. (h) Design and construction of the models have been completed; the testing program is in progress.

(1341) (a) MODEL EVALUATION OF CAVITATION ACTION, CLAYTOR DAM, NEW RIVER, VA. (b) The District Engineer, U. S. Engineer Office. Huntington, W. Va. (c) Model study of cavitation action on baffle piers. (d) and (e) See (415). (f) To analyze the relationship of the pressure fluctuation with the transferability of turbulence. (g) Claytor Hydroelectric Project is located on New River near Allisonia, Va. In addition to the regulation of flow for power development, flow is passed through two outlets located in the spillway and controlled by 5-ft gate valves. Nine spillway gates are used to control extreme floods. Maximum flow over the spillway occurred during the flood of August 13-16, 1940, when a discharge of approximately 200,000 cfs was passed under a head of 28.5 ft. The stilling arrangement below the spillway consists of a short apron with a row of baffle piers and an end sill. The model involved in this study is a 1-to-36-scale section model of 5 central bays of the spillway and stilling basin. (h) Design and construction of the model have been completed; the testing program in progress.

(1342) (a) DEVELOPMENT OF DYNAMIC PRESSURE-MEASURING EQUIPMENT. (b) Chief of Engineers, U. S. Army. (c) Development of suitable amplifying equipment for use with resistance-type strain cells for making dynamic pressure measurements. (d) and (e) See (415). (f) To develop an amplifier having high gain and negligible time lag for use in recording transient phenomena. (g) Investigations of both the modulated wave type of amplifier with rectified and filtered output, and of the direct coupled type of amplifier are being made. The pressure cell involved has a resistance gage as its measuring element; a change in pressure produces a corresponding change in the resistance of the gage. A number of circuits have been investigated. It is desired to obtain a change of 20 milliamperes in the amplifier output current for a change of one ohm in the resistance of the input circuit. (h) Several amplifier circuits have been constructed and tested. Six d.c. amplifiers patterned after the most satisfactory circuit developed are now being constructed for use in making bomb pressure records in conjunction with Carlson stress meters. Experiments with a high frequency modulated wave type of amplifier are also in progress.

(1343) (a) DEVELOPMENT OF A DYNAMIC-PRESSURE METER. (b) U. S. Waterways Experiment Station. (c) Development of a device for measuring extremely rapid fluctuations of water pressure in models. (d) and (e) See (415). (f) To develop a device for studying the effect of rapid variations in water pressure in hydraulic models. (g) The dynamic-pressure meter is fundamentally a combination of the ordinary piezometer with a dynamic pressure cell. The piezometer, instead of being connected with the usual glass manometer tube, is joined by a rigid pipe to a small pressure chamber, through which the pressure at the piezometer opening is transmitted unchanged to the active face of the dynamic-pressure cell, which electrically measures and records on an oscillograph the instantaneous values of the pressure. (h) A dynamic-pressure meter equipped with a "pressure probe" has been installed in a model of a drydock to record conditions within a pump intake, both as originally designed and after improvements were made. The probe consists merely of a movable piezometer of small size connected to the meter. Measurement of dynamic impulses on the faces of baffle piers in spillway models was made by making piezometer openings in the faces and connecting these holes, by means of rigid tubing, to the meter-oscillograph hookup. (i) The dyanmic-pressure meter, with the probe and the recording equipment, is an efficient and compact solution to the problem of measuring extremely rapid pressure fluctuations in a body of water.

(1344) (a) DEVELOPMENT OF A WAVE HEIGHT MEASURING DEVICE. (b) U. S. Waterways Experiment Station. (c) Development of a wave height measuring device for use on wave models and for possible adaptation to prototype measurements. (d) and (e) See (415). (f) To develop a device for measuring wave heights varying from 0.01 to 1.0 ft with an accuracy of within 5 percent. (g) Investigations have been made of several methods of varying the resistance in an electrical circuit by the variation in water height. A rod having contacts spaced at even vertical intervals, connected in series through resistances, and having a copper strip running the length of the rod for the return circuit, was developed and proved satisfactory. Water serves to complete the circuit between the contacts and the copper strip, and as the water rises and falls resistance is taken from and added to the circuit. The resistances are so computed that the current output of the circuit is linear with respect to wave height. Experiments were also made with two vertical rods using water to complete the electrical circuit, but this method gave a linear output over only a small vertical range. (h) The resistance type rod has proved very satisfactory. Rods have been constructed and utilized for measuring model waves ranging from a few hundredths of a foot up to several feet. (i) Future investigations for the improvements of the device are planned.

(1345) (a) TESTS OF A NEW TYPE CENTRIFUGAL PUMP. (b) The President, Mississippi River Commission, Vicksburg, Miss. (c) Testing of a new type centrifugal pump under diverse conditions. (d) and (e) See (415). (f) To determine the performance characteristics of the pump throughout the full speed range (800 rpm to 3600 rpm), and to obtain head-discharge-efficiency curves and make comparisons with data on conventional centrifugal pumps. (g) The pump was connected to test apparatus which recorded the speed, horsepower, discharge, and head of each test condition. Tese conditions were: increments of speed from 800 rpm to 3600 rpm; and increasing discharge from no flow to maximum. The recorded data were converted by means of standard test formulae in accordance with code specifications, and presented as conventional head-discharge-efficiency curves. (h) A detailed description of the tests and results is contained in the final report entitled, "Tests of Operation of Centrifugal Pump", which may be obtained on a loan basis from the Waterways Experiment Station Library.

(1346) (a) DEVELOPMENT OF A HYDROSTATIC PRESSURE CELL FOR MEASURING PORE-WATER PRESSURE IN EARTH STRUCTURES AND FOUNDATIONS. (b) U. S. Waterways Experiment Station. (c) Scientific research. (d) and (e) See (415). (f) To provide a suitable means for measuring pore-water pressures in earth dams and foundations. Secondary application, such as measuring wave pressures, to follow. (g) The device developed to date consists of a closed chamber containing a diaphragm with a wire cable leading from the chamber to a convenient terminal point. A perforated plate and screen placed in front of the diaphragm prevents soil from coming in contact with the diaphragm but allows the pore-water pressure to act freely on it. The pressure is measured by the change in resistance of an SR-4 wire resistance strain gage which is cemented to the diaphragm. Temperature compensation is accomplished by a dummy gage (a duplicate of the active gage) which is cemented to a dummy plate. Readings are made of the difference in resistance between the two gages by a special Wheatstone bridge. (h) An installation in the foundation and embankment of an earth dam has been made. Further installations are planned. Although readings have been taken for only a short period, the cells appear to function satisfactorily. A cell in the laboratory, under a constant pressure for six months, has read that same pressure consistently. (i) Readings and observations will be continued.

UNITED STATES WEATHER BUREAU.

(1240) (a) INVESTIGATION OF EDDY-CONDUCTIVITY METHOD OF DETERMINING EVAPORATION FROM LAND AND WATER SURFACES. (b) U. S. Weather Bureau. (c) Experimental verification of theory of moisture transport through the atmosphere and development of instrumentation necessary for field application of the procedures. (d) H.C.S.Thom, R.E.Lundquist. (e) Merrill Bernard, Supervising Hydrologist. (f) To furnish a rational procedure for measuring evaporation from land and water surfaces. (h) Work on this project was limited to that of a theoretical nature. Experimental data obtained during the summer of 1940 were found not to be in agreement with the somewhat generally accepted logarithmic law. Evaporation computed by formulas assuming this law were found to greatly over-estimate the true evaporation. The theory of the psychrometer is being studied further with a view to improving the measurement of humidity gradients in the lower atmosphere.

(1241) (a) MAXIMUM POSSIBLE RAINFALL OVER OHIO RIVER BASIN ABOVE PITTSBURGH, PA. (b) Corps of Engineers, U. S. Army. (c) Flood control works. (d) Hydrometeorological Section, Office of Supervising Hydrologist and Service Coordinator. (e) Merrill Bernard, Supervising Hydrologist. (h) During the past year considerable advance has been made in the Hydrometeorological Section of the U. S. Weather Bureau in developing theories and techniques in connection with estimates of maximum possible precipitation and stream flow. The latest study issued by this section, "A Report on the Maximum Possible Precipitation over the Ohio River Tributary Basins above Pittsburgh, Pennsylvania," is developed upon these improved methods. (i) The Hydrometeorological Section is organized under the Office of the Supervising Hydrologist of the Weather Bureau and is headed by Mr. Albert K. Showalter. Funds for the operation of the section are transferred to the Bureau by the U. S. Corps of Engineers.

ABSTRACTS OF COMPLETED PROJECTS AND REFERENCES TO PUBLICATIONS.

UNIVERSITY OF CALIFORNIA, College of Agriculture, Davis, California.

(271) MOVEMENT OF MOISTURE THROUGH SOILS. The following reports have been published:

1. Water-holding capacity of soils and its effect on irrigation practices. Agr. Engr. 19:487-490, 1938. by F. J. Veihmeyer and A. H. Hendrickson.
2. Evaporation from soils and transpiration. Am. Geophysical Union Trans. Pt. 2:612-619, 1938, by F. J. Veihmeyer.
3. Effect of organic matter on the infiltration of water into soils. Am. Geophysical Union Trans. Pt. 1:326-342, 1938, by F. J. Veihmeyer.
4. The validity of the assumption that it is possible to produce different moisture-percentages in field-soils. Am. Geophysical Union Trans. Pt. 4: 543-545, 1939, by F. J. Veihmeyer.
5. Field measurements of water movement through a silt loam soil. Amer. Soc. Agron. Jour. 33(8):713-731, 1941, by N. E. Edlefsen and G. B. Bodman.
6. Moisture distribution in soil in containers. Plant Physiol. 16(4):821-826, 1941, by A. H. Hendrickson and F. J. Veihmeyer.
7. Infiltration rates in a Yolo loam soil as affected by organic matter. Proç. Amer. Soc. Hort. Sci. 39:16-18, 1941, by A. F. Pillsbury and M. R. Huberty.
8. Factors influencing infiltration-rates into some California soils. Trans. Amer. Geophysical Union, 1941, pages 686-697, by M. R. Huberty and A. F. Pillsbury.

(272) CHARACTERISTICS OF SPRINKLERS AND SPRINKLER SYSTEMS FOR IRRIGATION. The following reports have been published:

1. Four new movable sprinkler machines. Pacific Rural Press 136(16):361, 354, 355, Oct. 15, 1938, by J. E. Christiansen.
2. Sprinkler systems for orchards. Pacific Rural Press 137(11): 254-255, March 18, 1939, by J. E. Christiansen.
3. Perforated drag-type sprinkler lines. Pacific Rural Press 139(8):286, Apr. 20, 1940, by A. F. Pillsbury.
4. Portable drag-type sprinkler unit for orchards. Agr. Engr. 21(5):182, 186, May 1940, by J. E. Christiansen.
5. Hydraulics of sprinkling systems for irrigation. (Closure of paper) Proc. Amer. Soc. Civ. Eng. 67 (9):1738-1740, Nov., 1941, by J. E. Christiansen.

(666) THERMODYNAMIC STUDIES OF EVAPORATION FROM FREE WATER, SOIL, AND PLANTS. The following reports have been published:

1. Evaporation from soils and transpiration. Am. Geophysical Union Trans. Pt. 2:612-619, 1938, by F. J. Veihmeyer.
2. Electrical methods of measuring soil moisture. Pacific Rural Press 139(8):291, Apr. 20, 1940, by N. E. Edlefsen.
3. The four-electrode resistance method for measuring soil-moisture content under field conditions. Soil Sci. 51(5):367-376, May, 1941, by N. E. Edlefsen and A.B.C. Anderson.

(667) HYDROLOGY OF IRRIGATION WATER SUPPLIES IN CALIFORNIA. The following reports have been published:

1. A theory of silt transportation, by W. M. Griffith. Discussion of article by J. E. Christiansen in Proc. Amer. Soc. Civ. Eng., 64:2062-4, Dec. 1938.
2. Chemical composition of ground waters. Civ. Eng., 11(8):494-495, Aug., 1941, by M. R. Huberty.
3. Hydrologic studies of the Putah Creek Area in the Sacramento Valley, California. Hilgardia 14(3): 119-146. Oct., 1941, by M. R. Huberty and C. N. Johnston.
4. Chemical composition of water in the Putah Creek Basin. Hilgardia 14(3):147-160, Oct., 1941, by C. S. Bisson and M. R. Huberty.

UNIVERSITY OF CALIFORNIA, College of Agriculture, Los Angeles, Calif.

(1157) PHYSICAL AND CHEMICAL FACTORS AFFECTING SOIL INFILTRATION RATES. The following reports have been published:

1. Factors influencing infiltration rates into some California soils. M. R. Huberty and A. F. Pillsbury, Trans. Amer. Geoph. Union, 1941, 688-694.
2. Infiltration rates in a Yolo loam soil as affected by organic matter, A. F. Pillsbury and M. R. Huberty, Proc. Amer. Soc. Horticultural Sci., Vol. 39, 1941, 16-18.

UNIVERSITY OF CALIFORNIA.

Theses on the following projects are on file at the University of California Hydraulic Laboratory:

(799) EFFECT OF VISCOSITY ON THE CHARACTERISTICS OF CENTRIFUGAL PUMPS.

(802) THE DESIGN OF A PROPELLER TURBINE.

(1040) DAMS ON PERVIOUS FOUNDATIONS.

(1044) MODEL STUDY OF WAVE REFRACTION.

(1258) FLOW CHARACTERISTICS OF DRILLING MUDS.

(1259) UNSTEADY FLOW THROUGH POROUS MEDIA FROM A FREE SURFACE.

(1260) THE EFFECT OF WALL FRICTION ON WAVES IN A STRAIGHT CHANNEL.

THE STATE UNIVERSITY OF IOWA.

(1036) DISCHARGE COEFFICIENTS FOR OBSTRUCTIONS TO SUPER-FLOOD FLOWS. A generalized model of a river channel was tested to determine discharge coefficients for bridges using the most critical combination of run-off and ground water conditions that is possible on any watershed in the Rock Island District. A model study was also made of the Des Moines River at the junction of the Raccoon River, observing backwater effects of bridges and dams. Discharge coefficients for bridges on these rivers were computed.

FOREST SERVICE, California Forest and Range Experiment Station.

(1303) THE SAN DIMAS METERING FLUME. The San Dimas flume has been tested in the laboratory with clear water using flumes six inches and one foot wide. As a result of these tests the following design has been adopted. The San Dimas flume consists of a parallel wall flume section, the width of which is designated as "flume width" (W) with cylindrical entrance walls forming a transition section. The characteristics of the transition and flume sections are as follows: Transition section 1. Cylindrical entrance walls with radii of 2-W. 2. Width of upstream end equals 2-W. 3. Width at parallel wall section equals W. 4. Floor is level. Parallel wall flume section. 1. Floor slopes on a 3 percent down grade from the transition section. 2. Width of flume section equals W. 3. Length of flume section equals 2-W. 4. Head is measured by means of two vertical slots, one on each side of the flume and located in the middle of the parallel wall section. These slots open into a silt chamber which is connected to a water stage recorder stilling well. 5. Maximum measurable head equals W. The adopted design has: 1. A stable relation between head and discharge. 2. A minimum of turbulence through the flume. 3. A small variation in rating due to: (a) Changes in approach channel slopes from level to seven percent. (b) Changes in floor slopes of the parallel wall section from two to four percent. (c) Changes in roughness of material used for construction of models from Manning's "n" of 0.010 to 0.015. (d) Obstructions placed in the approach channel, amounting to slightly more than one-half of the approach channel width. 4. The ability to maintain the parallel wall section clear of bedload. 5. A close relationship between water surfaces and pressure head at the measuring section. Results have been reported as follows: "Measurement of Debris-laden Stream Flow with Critical-depth Flumes" by H. G. Wilm J. S. Cotton, and H. C. Storey. Trans. Am. Soc. Civil Engrs., Vol. 64, No. 8, Part 2, 1938, pp. 1237-1278. In preparation: "The San Dimas Stream Gaging Flume, A Code for Dimensions, Installation and Operation," by S. M. Munson, Karl J. Bermal, and H. C. Storey.

(1305) WATERSHED MANAGEMENT. Publications during the period 1938-1941 include:

1. An Analysis of precipitation measurements on mountain watersheds, by H. G. Wilm, A. Z. Nelson, and H. C. Storey. Monthly Weather Review, Vol. 67, June 1939, pp. 163-172.
2. Topographic influence of precipitation, by H. C. Storey. Pacific Science Congress, Berkeley, August 3, 1939.
3. The San Dimas Experimental Forest, by C. J. Kraebel and J. D. Sinclair. Transactions American Geophysical Union, 1940, Part I, pp. 84-92.
4. San Dimas Experimental Forest, by E. L. Hamilton. Southern California Social Studies Review, Vol. 16, No. 5, Oct. 1940, pp. 10, 12 to 14.
5. The sample plot as a method of quantitative analysis of chaparral vegetation in southern California, by J. S. Horton. Ecology, Vol. 22, No. 4, Oct. 1941, pp. 457-468.

(1308) INFLUENCE OF FOREST VEGETATION ON STREAMFLOW AND EROSION. Publications since 1940 include:

1. Rowe, P. B. Influence of woodland-chaparral vegetation on soil-water relations. Manuscript submitted for publication as U.S. Dept. Agric. Bull. March 1940.
2. Rowe, P.B. Some factors of the hydrology of the Sierra Nevada foothills. Trans. Amer. Geophysical Union, 1941, Part I, pp. 90-100.

(1309) INFLUENCE OF FOREST VEGETATION AND LAND USE ON STREAMFLOW AND SOIL EROSION. Publications in connection with this project include:

1. Rowe, P. B., D. M. Ilch, and Rene Bollaert. An infiltration study of a denuded and a forest covered soil. California Forest & Range Experiment Station Research Note No. 14, 1937. Mimeo.
2. Rowe, P. B. The construction, operation, and use of the North Fork infiltrometer. U.S.Dept. Agric. Flood Control Coordinating Committee Misc. Pub. No. 1, 1940.

NATIONAL BUREAU OF STANDARDS.

(797) PLUMBING MATERIALS AND EQUIPMENT AS RELATED TO LOW COST HOUSING. The following reports on this project and the related project 42 have been published and may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at the prices indicated (stamps not accepted):

National Bureau of Standards Research Paper RP1086, "Cross-connections in Plumbing Systems", by R. B. Hunter, G. E. Golden and H. N. Eaton, April 1938, 15 cents per copy;
National Bureau of Standards Report BMS28, "Backflow Prevention in Over-rim Water Supplies", by G. E. Golden and R. B. Hunter, August 1939, 10 cents per copy;
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(979) DREDGE SUCTION BOOSTER. A dredge suction booster consists of an auxiliary pump or pump impeller mounted in the suction pipe of a dredge near its mouth. The purpose of the booster is to increase the output of dredged materials and to facilitate dredge operation. This is achieved by increasing the available energy in the suction pipe. The following general conclusions are based on the laboratory tests of a pump-booster combination operated at a constant discharge pressure equal to zero (atmospheric pressure). They are valid for operation at any other constant discharge pressure.

I. For any given set of conditions there is a critical booster speed below which the booster acts as an obstruction dissipating energy supplied by the dredge pump, and above which the booster is a source of energy.

The following conclusions apply when the booster operates above its critical speed.

II. For any given concentration of dredged materials a booster increases the velocity of flow and the output of dredged materials.

III(a) For any given output of dredged materials a booster decreases the vacuum at the dredge pump.

III(b) For any given concentration or velocity, the virtual vacuum, as defined below, can be greatly increased by a booster. Therefore the dredge can operate under conditions which, without a booster, would lead to a vacuum higher than that which the dredge pump can develop. (The energy in the suction line is measured by the sum of the vacuum at the dredge pump and the differential head produced by the booster. In the report this sum has been named the virtual vacuum.)

IV. A booster increases the maximum output of dredged materials, increases the vacuum at the dredge under these maximum conditions.

The same lot of sand was used in all the tests to represent dredged materials. No attempt was made to investigate the effects of varying discharge pressures at the dredge pump, or to design the most efficient type of booster impeller.

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(1153) STUDY OF OSCILLATORY WAVES IN WATER. Report now at printers: Technical Paper No. 1.

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RESEARCH COMMITTEES.

NATIONAL RESEARCH COUNCIL INTERDIVISIONAL COMMITTEE ON DENSITY CURRENTS.

Chairman: Herbert N. Eaton, National Hydraulic Laboratory, National Bureau of Standards, Washington, D.C.

The Subcommittee on Lake Mead (C. P. Vetter, Chairman) has issued its report on the field observations at Lake Mead made by the staff of the U. S. Bureau of Reclamation. The report describes the equipment and methods used in obtaining the field data and includes all of the physical and chemical data obtained over a period of three years. The data include water temperatures, conductance, chemical analyses, percentage silt determinations, particle sizes, depths to surface of layer of silty water, and velocities. The chairman of the main committee has a few copies of the report which can be loaned to interested persons for a limited time. It is planned to prepare a final report describing and interpreting the observations for publication by the National Research Council.

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